

Aircraft *interiors* INTERNATIONAL

NOVEMBER 2016

In this issue

FINNAIR'S CEO

In an exclusive interview, Pekka Vauramo discusses the importance of investment in hard product, and the financial benefits

LI-FI

Cabin lighting could offer a solution to congested wi-fi channels

LIGHTING

The newest developments in the innovative aerospace lighting sector, and what the future could hold

MATERIALS SPECIAL

The latest materials and finishes you won't want to miss, plus find out what's on the wish lists of the world's top CMF experts

DISCOVER THE
TRUE POTENTIAL
OF 3D PRINTING
IN THE FUTURE
OF CABIN DESIGN
AND PRODUCTION

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THE THIRD DIMENSION

Could aerospace be on the eve of revolution? Additive layer manufacturing is being heralded by many as the next big thing in the aircraft interiors sector, bringing a renaissance in product design, form factors and production. Indeed serious industry players have been investing heavily in the technology, including Airbus, which has set up APWorks, a dedicated 3D printing division based in Munich, and Boeing, which recently created the world's largest solid 3D printed item, a tool used to secure the B777X composite wing skin for drilling and machining.

A new way of manufacturing is certainly interesting, but it's the potential advantages it brings that are fascinating. Need an urgent replacement for a non-standard component damaged during a flight? No problem, even when the aircraft is heading somewhere remote: simply contact headquarters and have them arrange for the destination airport's on-site printing facility to manufacture a replacement, which will be ready to be fitted upon arrival.

The convenience and efficiency would be tremendous, and the savings diverse, including slashed storage, inventory and cargo costs, with further benefits including cabin product remaining in service on every flight, and parts for older aircraft remaining readily available. And that's just one example, with the many other benefits of the technology including enabling the

creation of elegant, lightweight structures that cannot be achieved using traditional manufacturing methods.

Of course we're not there yet, but the technology is advancing rapidly and has already been used in some small-scale trials such as Air New Zealand's 3D-printed cocktail tables. The manufacturing process itself shouldn't present an issue – the real issue is in ensuring the printed product is safe, the intellectual property remains secure throughout the process (especially when proprietary design files are sent around the world), and the certification authorities are at ease.

These issues have been explored in our cover feature on p28, with further exploration into 3D printing advances on p38, where we look at the latest developments across several industries that could influence the aerospace sphere in the future. Continuing the 3D theme, we also discovered an advance in 3D injection molding that could benefit in-seat electronics (p22). We have looked at the largest cabin parts that could be printed, such as sidewall panels (p48), and the smallest, including research into golden 3D-printed nowalls that could further improve the operation of IFE touchscreens (p12).

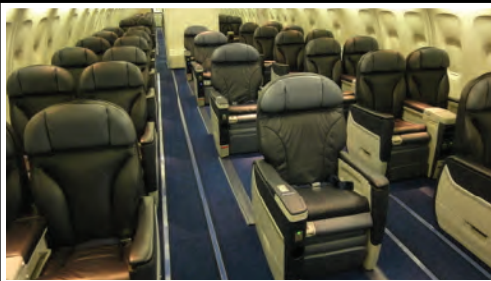
The scale of its implementation remains to be seen, but 3D printing will play a role in the future of aircraft interiors and we will enjoy watching the technology take shape. ✕

Adam Gavine, editor



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- 008 The latest trends and developments entering the passenger experience airspace. In this issue we have our regular roundup of industry statistics, exciting developments at Qantas, how 3D printing can enhance IFE, how the middle seat proposition might improve, and more...
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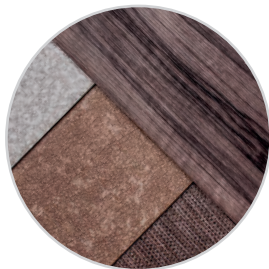
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Find out more about Caon Studio's design work in the Articles section of our website

DARE TO DREAM

Qantas has big plans for its Dreamliners, with a refreshing focus on the rear cabins and a new studio bringing a fresh design perspective

1. THE BIG CHANGE WITH THE B787-9 SUITES IS THE ADDITION OF ADJUSTABLE DIVIDERS BETWEEN THE CENTER DOUBLES

2. ECONOMY PASSENGERS BENEFIT FROM AN ALL-NEW SEAT AND A 32IN PITCH

Standards have been going up Down Under, with Qantas developing yet more enhanced cabin product, this time ahead of the arrival of its first B787-9s in 2017. These aircraft will be the new flagship for the airline, replacing its aged B747 fleet, and the interiors promise to be a little special, with an updated business class seat, new seating in economy and premium economy, and even a new designer driving the project.

The interiors have been designed by Australian industrial designer David Caon, as a progression of the Qantas aesthetic previously established by Marc Newson. Caon is known to Qantas, having participated in previous projects with the airline, including B717 cabins, and international lounges.

The Business Suite will look familiar to frequent Qantas flyers, as it is an updated version of the seat that launched on the A330 fleet in late 2014. The 42 suites are based on the Thompson Vantage XL platform, customized to further increase privacy options through the addition of adjustable dividers between the center seats in the 1-2-1 cabin.

The really exciting developments are toward the rear of the 236-seat aircraft, with the brand-new 28-seat (2-3-2) premium economy cabin

claimed to offer a "class-leading experience" and a "revolutionary new seat", both of which will be unveiled in early 2017.

The 166 economy passengers will also enjoy an all-new seat, with a 32in pitch that offers an inch more comfort than on the national carrier's A380s. Further comforts will include new features such as a personal device holder and USB ports, new and additional storage areas, a seatback mood light, and a HD IFE display 5% larger than the airline's current 10.6in displays. The seats, designed by Caon's studio in Sydney, will also feature an updated version of the airline's popular 'footnet' first introduced on its A380s, designed to cradle the legs during sleep.

"We're planning to make the most of the B787's amazing range, so we've designed the cabin to give Qantas passengers a better experience on long-haul flights," stated Qantas CEO Alan Joyce. "Many of the cabin design elements reflect what our customers have told us. Personal storage rates really highly, so we've created extra space in economy for customers to store their personal devices and water bottles. We're proud that our new economy seat includes features other carriers reserve for premium economy." ✕

aircraftinteriorsinternational.com will be first with details and images when the premium economy designs are revealed



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SOMETHING BEGINNING WITH 'A'

As Airbus celebrates a milestone – its 10,000th aircraft delivery – let's take a moment to remember some moments that shaped its success

1

WHERE IT ALL BEGAN

Being born in 1970, Airbus is a youngster compared with other aircraft manufacturers, but what a lot it has achieved. The company was first established to develop and manufacture the A300, the world's first twin-engined wide-body, designed to compete against three-engined TriStar and DC-10 rivals in terms of cost, size and efficiency. That wide-body cabin could provide comfort for passengers on short and medium routes, but the notion of a short-haul wide-body appealed to few airlines. However, with longer-range variants introduced, as well as cargo versions, the A300 soldiered on from its launch with Air France in May 1974 until production ceased in 2007. The A300 is a key part of the Airbus DNA, with particularly close links to the A330 and A340.



2

ENTER THE GIANT

In mid-1988, a group of Airbus engineers began a secret project to take on the might of Boeing's iconic Jumbo. The team, led by chief engineer Jean Roeder, began working on the 'A3XX', with some of the wackier ideas including a catamaran-style aircraft combining two A340 fuselages. Of course the final result was the beautiful double-deck A380, the world's largest passenger airliner; indeed the A380, which was launched in 2007 with Singapore Airlines, is so large that airports have had to upgrade their facilities to accommodate it. Across the two decks, the A380-800 boasts 550m² (5,920ft²) of usable floor space – some 40% more than the Boeing 747-8. Like the A300, some carriers are struggling to make the economics of the A380 work for them, but this is an aircraft with so much potential, being anything from an 853-seat economy bus, to the private version enjoyed by Saudi Prince Alwaleed bin Talal.



3

A LANDMARK A350

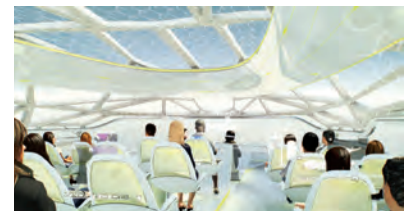
Positioned to succeed the A340, and to compete with Boeing's 787 and 777 models, the high composite content of the super-advanced A350 XWB offers several passenger experience advantages to rival the Dreamliner. On October 14, Airbus celebrated a milestone event: the delivery of its 10,000th aircraft. The aircraft was an A350-900 for Singapore Airlines – its sixth out of a total order for 67. Singapore Airlines has an important role in Airbus's history: the airline placed its first order with Airbus in 1979, and over the years the carrier and its subsidiaries have ordered every successive Airbus model – and Singapore was of course the first to take delivery of the A380. A second version of the A350 XWB – the A350-1000 – is set for delivery in Q3 2017.



4

A BIONIC FUTURE

In 2011, Airbus revealed its Concept Cabin as an indication of how the flying experience could look in 2050. It certainly looks different, and a more socially inclusive experience, with today's classes replaced by zones that target more individual needs such as relaxing, socializing or holding business meetings – just like people do when they're on the ground rather than inside a tube. Nervous flyers may not appreciate the panoramic view offered by the cabin's bionic structure, but they will like the responsive membrane, which has an integrated neural network pulsing through it to identify and respond to the needs of each passenger. While cabin classes are removed, by offering different levels of experience within each zone, airlines would be able to achieve the price differential they need to operate a successful business.



5

THE WAY FORWARD

Airbus research has found that aircraft type can be important to airline brand perception, leading it to create a new brand of its own: Airspace by Airbus. The brand has values that will extend across the model range, offering strong and recognizable cabin characteristics such as the minimum 18in seat width in economy and a clean white backdrop to appeal to designers, and Airbus hopes that passengers will seek out flights with Airspace cabins. The first Airspace-equipped aircraft will be an A330neo, launching in 2017 with TAP Portugal. ✕



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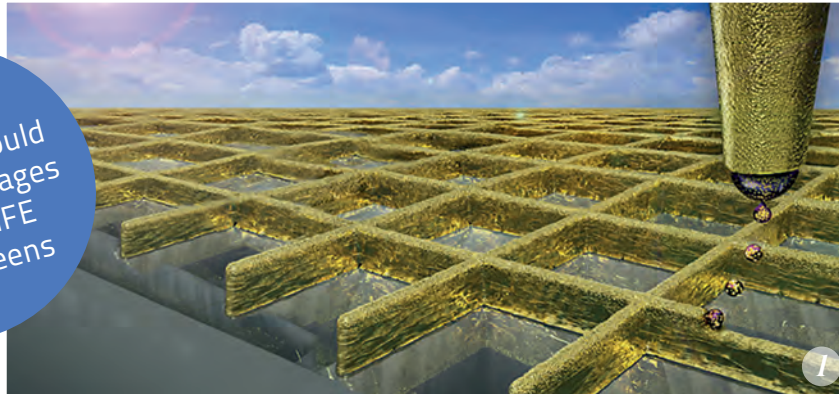
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3D-printed nanowalls offer advantages for large IFE touchscreens



1. BY PRINTING NANOWALLS TALLER THAN THEY ARE WIDE, CONDUCTIVITY AND NEAR INVISIBILITY CAN BE ACHIEVED

SMALL MIRACLE

Much of the focus for 3D printing in the cabin has been on the potential for creating large structures, but a team of scientists has discovered it also has huge potential on the nano scale, particularly for IFE displays

It's easy to take touchscreen technology for granted today, with its proliferation in everything from smartphones and tablets, to ATMs and of course IFE displays. Transparent electrodes make the magic happen, thanks to a pattern of conductive material that recognizes whether and exactly where a finger is touching the surface. The next step in the technology could be enabled by using 3D printing on a nano scale.

A team at ETH Zurich (the Swiss Federal Institute of Technology in Zurich) has developed a way to 3D print electrodes, creating a new type of near-transparent electrode that takes the form of a grid made of gold or silver 'nanowalls' on a glass surface.

This is the first time that such nanowalls have been created using 3D printing, and the results have been positive according to the research team. The nanowalls are so thin (80-500nm) as to be invisible to the naked eye, while the electrodes have a higher conductivity and are more transparent than those made of indium tin oxide, the standard material used in today's touchscreens. The more transparent the electrodes, the better the screen quality, and the more conductive they are, the more quickly and precisely the touchscreen will work.

To produce more conductivity than in today's indium tin oxide electrodes, the ETH Zurich

researchers opted for gold and silver, which conduct electricity better.

Dimos Poulidakos, professor of thermodynamics at ETH Zurich, explained, "If you want to achieve both high conductivity and transparency in wires made from these metals, you have a conflict. As the cross-sectional area of gold and silver wires grows, conductivity increases, but grid transparency decreases."

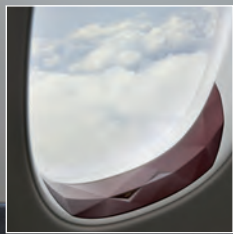
However, these scientists increased the transparency by making the nanowalls taller than they are wide (two to four times taller), achieving the required conductivity while being nearly invisible from a user's viewing angle. ✕

BUILDING WALLS

The metal nanowalls are created using a printing process known as NanoDrip, developed in-house by ETH Zurich. The process is based on electrohydrodynamic ink-jet printing, a process in which inks made from metal nanoparticles are applied in a solvent, and an electrical field draws ultra-small droplets of the metallic ink out of a glass capillary. In this process the solvent evaporates quickly, enabling a three-dimensional structure to be built up, nanodrop by nanodrop.

According to the team, the really special aspect of the NanoDrip process is that the droplets that come out of the glass capillary are about 10 times smaller than the aperture itself, enabling very small structures to be printed.

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SWELL TIMES

Airlines are doing well, and the interiors sector is continuing its impressive growth trajectory, but while passengers' money is welcome, some of their behavior is not

Cabin fever

There were 10,854 unruly passenger incidents in 2015, compared with 9,316 in 2014. Verbal abuse was the most common incident, with 11% involving physical aggression, and 23% being alcohol- or drug-fueled

IATA

Seating

The global aircraft seating market will grow from **US\$8.74bn** in 2016 to **US\$16.94bn** by 2022 at a CAGR of **14.15%**



Research and Markets

More than 19,500 aircraft will have connectivity by 2025 – up from 5,233 at the end of 2015

Valour Consultancy

51% of passengers would prefer to use their own PED for IFE: **12% more than in 2015**

IATA Global Passenger Survey

The aircraft seat actuation systems market will be worth **US\$282.69m** by 2020, growing at a CAGR of **9.64%**

Marketsandmarkets

Boeing projects a demand for **6,810** new airplanes in China over the next 20 years, worth **US\$1.025tn**

The aerospace fasteners market will be worth **US\$7.73bn** by 2021

Marketsandmarkets

The global aerospace overhead stowage bin market is expected to reach **US\$506m** by 2021, at a 5.1% CAGR

Stratview Research

JET SET PETS

11,960 pets flew in business aircraft in Europe this year

Magnus Aviation

Ancillary earners

The top five ancillary revenue earners in 2015

- 1 United: US\$6.1bn**
- 2 American: US\$4.7bn**
- 3 Delta: US\$3.8bn**
- 4 Air France/KLM: US\$2.2bn**
- 5 Southwest: US\$2.1bn**

The top five ancillary revenue earners in 2015 per passenger

- 1 Spirit: US\$51.80**
- 2 Jet2.com: US\$50.84**
- 3 Allegiant: US\$49.94**
- 4 United: US\$44.16**
- 5 Qantas: US\$42.70**

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Aeroméxico video and image content is available on our website, and a blog from New Territory

SOCIAL GRACES

The social space on Aeroméxico's Dreamliners is designed to make business class a little less corporate and a lot more homely and welcoming

1. PARTICULAR CARE WAS TAKEN WITH THE ILLUMINATION TO MAKE SURE THE INFLIGHT FOOD AND BEVERAGES LOOK APPEALING

2. BY PUTTING DIFFERENT FUNCTIONS ON DIFFERENT FACETS, CONGESTION IN THE SPACE IS REDUCED, AND VISUAL INTEREST INCREASED

3. DETAIL OF A DOOR 2 LIGHTING FEATURE, WHICH CONTINUES THE FREE-FLOWING FEELING

The inflight experience should have a focus on increasing passenger wellbeing, and if there is a social space onboard it should be able to accommodate all eligible guests, and their varying moods, whether they want some alone time or a fun time. These were the key thoughts in the design of Aeroméxico's B787-9 interiors, which should help flyers on Mexico's flag carrier feel at home in the air.

For the Door 2 social area, the team departed from the notion of a business class bar with a few stools, which can become a first-come, first-served experience, to create a welcoming kitchen-style environment integrated into the architecture of the aircraft.

The team also adopted a few Mexican cultural cues for the cabin design, including 'beneficio colectivo' (collective benefit), which was translated into a sense that the social space should communicate a feeling of openness and of casual, convivial equality.

"We observed that not everyone feels relaxed enough to talk when they're at a bar, so we designed the social space to feel and work less like a traditional bar and more like a beautiful domestic space. Here passengers feel relaxed enough to help themselves to drinks and refreshments, choosing if and how they interact with fellow passengers," explains Luke Miles, director at New Territory, a transport architecture studio brought in by the airline for the project.

A large overhead 'skylight' lighting feature bathes the space with a warm, natural-feeling light, which highlights the multifaceted geometry of the space. The facets are intended to create an inviting feel and encourage the natural flow of people through the space, with clean, unbroken lines and shifting perspectives revealing different parts and sections of the bar as passengers walk through. People movement was a key consideration for the design team, who ensured that passengers will be able to move throughout the area while keeping the central service space free.

Watch the virtual tour of the aircraft on aircraftinteriorsinternational.com to see how the space works and how it fits in with the wider cabin environment. ✕

CONNECTED FLEET

April saw Aeroméxico become the first airline to offer Gogo's 2Ku inflight connectivity technology. The first installation was on a B737-800 with a Boeing Sky Interior, and as 2Ku technology is compatible with multiple satellite networks, it can be upgraded over time without having to modify the aircraft.

"The great news for Aeroméxico is it gets a leading technology today that

will only get better in the near future as newer high-throughput satellites come online," states Michael Small, Gogo's president and CEO.

The 2Ku system joins other Gogo technology that Aeroméxico has signed up for, including the Gogo Vision wireless IFE system, which is on Boeing 737-700 and Embraer aircraft flying across Aeroméxico's regional network.

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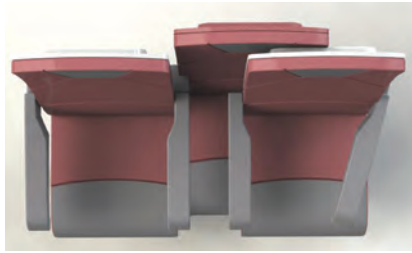
MIDDLE RIDDLE

How do you solve a problem like the middle seat? As a new seat model designed to enhance the inbetween experience hits the headlines, let's consider some recent developments

1

SLIDE ON OVER

At a time when Airbus and Boeing are debating the merits of 1in of extra seat width, an extra 2in for the middle seat sounds an interesting proposition. By setting the middle seat slightly behind its neighbors, Molon Labe Seating has managed to yield a 20in middle seat in its Side-Slip Seat design – as well as additional lateral space and armrest space. Better still, during boarding, the aisle seat can be slid over the middle seat to create around an extra 24in of aisle width for faster boarding – up to a claimed 30% less time. The design has gone beyond the concept stage now, with the Colorado-based company saying that it expects the seat to be market-ready imminently following success in 16G dynamic tests.



2

TAILORED JUST SO

How about a middle seat that is as wide as you like – or at least as wide as you are willing to pay for it to be? Seymourpowell conceived the Morph concept as a departure from the notion of 'one size fits all' economy seats. Instead Morph is a standard product that can adapt to individual passengers, with a smart architecture allowing adjustments of seat width, seat pan height and seat pan depth. Passengers can opt to pay for a little extra space or even save money by opting for a smaller seat – for example a mum, dad and infant traveling together could pre-book a large, medium and a small space. Prior to boarding, crew simply move the formers on the hammock-like seats to the appropriate seat widths and push them through the fabric to clamp the mechanism into place for its new position.



3

JUST STAGGERING

A 20in-wide middle seat sounds great, but how about all three in a triple being 20in, without sacrificing cabin density? The Cozy Suite from Thompson Aero Seating is a staggered design that can operate from a 31in pitch, with a claimed gain of 2in on narrow-bodies. In addition to a little more width, passenger benefits include a natural place to rest their heads and increased shoulder space. Cozy Suite has been around for a few years, and we look forward to seeing which airline will step forward and commit to this innovative, if unconventional, design.



4

BIG WIDE WORLD

In 2012, prior to declaring an 18in standard economy seat width, Airbus revealed an interesting concept. Originally code-named '20/17/17' in reference to its seat widths in inches, and later renamed the Extra Wide seat, the idea behind the concept was to monetize Airbus's wide fuselage cross-sections by making 20in-wide aisle seats that could become a potential extra source of revenue, compensated for by narrowing the middle and window seats by 1in, to 17in. However, as the 18in minimum economy seat width has become a key marketing point for Airbus, the concept has been shelved.



5

OPPOSITES ATTRACT

A high-density design that packs in passengers while also offering 24in-wide seats in economy class sounds incredible. And it is; it's just that the reality of Zodiac's HD31 'yin yang' concept can create some interpersonal issues. The concept is an arresting proposition: with seven-abreast seating (4-3) at a 31in pitch, those 250 seats can be fitted in an A321 – an increase of 30 seats on average, which could only be achieved with forward-facing seats at a 27in pitch. The yin yang design also offers a seat width of 21in outboard and 24in in the center, as well as fast boarding times thanks to the cross aisles created by the flip-up pans. The downside? Perhaps the public just isn't ready to spend a whole flight facing someone they don't know in such proximity unless the fare is lower than usual. ✕



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TOUGH CUSTOMER



BRIEF

Passenger safety is paramount, but those restrictive head impact criteria requirements can really limit innovation and design expression in economy class seating. The solution is obvious: passengers need to be redesigned to be less fragile.

DESCRIPTION

Meet Graham, not just a handsome chap, but an enabler of new seat design possibilities. In an impact event, if his head strikes the seat in front, his broad, flat features help protect the key sensory organs, while the shape of his thick skull, with its internal crumple zones and additional fluid and ligaments, provides a strong shield for the brain and minimizes damage.

Graham doesn't have a neck; instead his ribcage extends to the skull, fusing his head with his broad shoulders, again strengthening the head area and reducing potential movement, removing the risk of whiplash or breakage of the neck. His chest is strong too, with extra fatty deposits between the ribs, acting as organic airbags that expel liquid during impact to absorb force and help protect the ribcage and internal organs.

Leg flail will be fairly dramatic during impact as extra tendons in his knees mean they can bend in any direction, but the chance of injury is reduced, especially since extra joints in his legs give the lower limbs added flexibility to reduce the impact force on the tibia in an accident.

People say Graham looks a little funny, but don't worry, he is thick-skinned – literally, to protect against abrasions and further protect the body.



VERDICT

Graham is the vision of a team from Victoria, Australia – a leading trauma surgeon, a car crash investigation expert and an artist – of how the human body would have to evolve to withstand the forces involved in impacts. He is not a frivolous art project; he has been created to demonstrate how vulnerable the human body is to the forces involved in impacts and to promote the need for safety.

If humans evolved to look like Graham, cabin design could be a little more elegant, with fewer measures required to protect passengers in the event of impact. The passengers themselves wouldn't be quite so elegant, but Graham is cute in his own way.

To explore beneath Graham's thick skin and understand how his unique features would work to cushion him from serious injury in an impact, visit www.meetgraham.com.au.



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SMOOTH OPERATOR



BRIEF

3D printing promises exciting opportunities, and it would be great to see form-factor innovations achieved through 3D injection molding, specifically in integrating electronics and lighting with seats.

DESCRIPTION

A Finnish company has developed a means of combining flexible printed circuitry and discrete electronic components to build fully integrated 3D injection-molded 'smart surfaces'. The technology, created by TactoTek, has been enabled by innovations in injection-molded electronics, including advances in conductive inks and in-mold labeling films, which are expanding usage of 3D injection molded structural electronics.

Those in-mold electronic inks are key to the process as they can enable lighter, less expensive electronics by reducing the need for rigid circuit boards, as well as opening the way for simplified structures and more attractive and creative styling.

For example, printed circuitry and sensors, and printed capacitive touch controls such as buttons and sliders for seat, IFE or PSU functions, could be incorporated directly into 2mm-thin injection-molded plastics to create customized and formed user interfaces.

The process also enables sophisticated lighting effects to be incorporated into very thin 3D plastics to create very bright, evenly distributed illumination within the smart surfaces. Many illuminated electronics designs include a cosmetic surface structure and a separate light pipe structure to direct lighting to the surface from a flat, rigid printed circuit board. By consolidating printed electronics and LEDs within the 3D molded plastic part, however, the plastics themselves can conduct light, offering engineering and styling advantages.



VERDICT

While many of today's electronic controls are attractive, they tend to be flat, straight strips. This technology could enable controls to be incorporated directly into curved, swooping forms, easily customizable for individual airlines. It's an exciting technology, with neat, high-tech finishes enabled by removing the design constraints of multipart assemblies, which also reduces weight and complexity.

It also opens the way for more closely incorporating lighting into seats, and using lighting effects to communicate information such as control features in an appealing way.

The technology is almost here, with a key enabler being that the manufacturing process enables fundamental processes, such as electronic component surface mounting, to be done in two dimensions using standard surface-mount technology and electronic components. Indeed TactoTek recently received a €2.5m EU Horizon 2020 award to mass produce injection-molded electronics. The initial applications are expected to be in the automotive, home appliances and wearables sectors, but the technology is surely worth investigating for aerospace application. ✕



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AHEAD OF THE CURVE



THE BRIEF

Function sometimes exceeds style in business class seating, resulting in angular, boxy designs. It would be interesting to see an idea for a premium seat that is highly curvaceous, and which looks crafted rather than engineered.

DESCRIPTION

For a fresh perspective in aerospace, garnering ideas from outside the industry can sometimes be effective. From the yacht design world, the studio of Alexander McDiarmid – nicknamed 'l'enfant terrible of yacht design' no less – has created a concept intended to make the cabin a curvier, more natural environment.

This business class suite is not meant to be the next big thing in efficient cabin density, but rather a 'what if' styling and CMF exercise. Before starting the design work, the team thought about the psychology of the cabin space, the perceived and real passenger experience, and how CMF choice can affect and contribute to a pleasant experience.

When exploring ideas for the design language, the studio found inspiration in the Australian boomerang, an object they felt had a flowing, elegant, simple and organic form, and a profile that lends itself surprisingly well to cabin design.

"From the very start we were adamant about using natural effect materials, not only due to their timeless design and style, but because such materials bring a calming effect to any interior space, enclosed or not," explains McDiarmid. "To maintain a comfortable yet productive area for the business passenger to work in, wood was the natural choice, as can be seen from its dominant use."

Wood is indeed the dominant finish, with the outer and inner shells clad in a light wood décor, with a relief of curved brushed metal inlays that wrap around the suite, transect the full-length shelf and swoop around the cabin.



VERDICT

While the seat is luxurious, with a sliding door and direct aisle access, Boomerang is not about the industrial design. Indeed it appears to draw from residential furniture design – an oft-cited aim in the design of today's premium classes – with hints of the classic Eames lounge chair. However, while the extensive use of wood creates a calm, natural feel in a space dominated by man-made materials, perhaps greater variation in grains and finishes could add a little more visual interest and further soften the aesthetic. The boomerang theme is a clever feature, though, formed in metallic swoops that flow throughout the cabin and tie the space together. It would be interesting to see how the styling of this concept could be applied to various catalog seats and different classes. It would also be intriguing to hear the views of the biggest fans of wood in the skies – Emirates and Swiss – about the concept. ✕



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future structures

THE DESIGN AND MANUFACTURING POSSIBILITIES OFFERED BY ADDITIVE LAYER MANUFACTURING ARE BECOMING WELL KNOWN, BUT THE TECHNOLOGY FACES GREAT CHALLENGES IN THE STRICT AVIATION INDUSTRY. IS 3D PRINTING THE FUTURE OF CABIN DESIGN AND PRODUCTION?

Words by Marisa Garcia. Illustration by Magic Torch



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“This is new territory, so unique standards must be set”

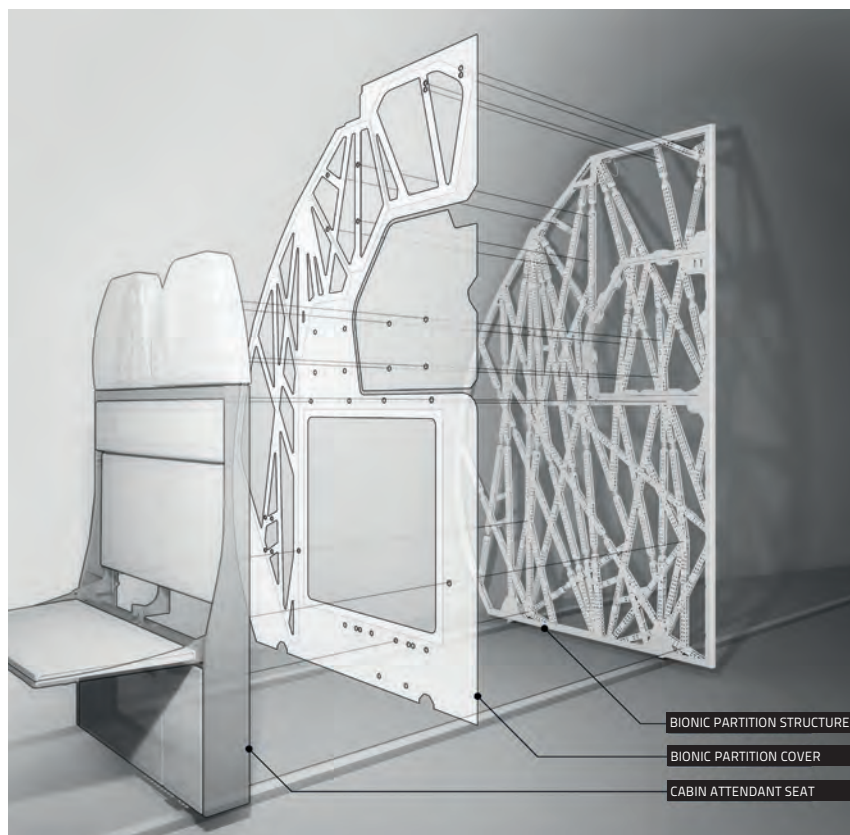
The technology of additive manufacturing (AM) or additive layer manufacturing (ALM) – more commonly known as 3D printing – promises to revolutionize manufacturing processes around the world and offers aviation new opportunities to create stronger, lighter structures, for both the airframe and the cabin.

Though 3D printing has clear advantages for the aerospace industry, there is a question of gaining certification approval for these parts, which use alternative raw materials and production processes. Thus the US FAA has formed an Additive Manufacturing National Team (AMNT), which is setting up the standards for an approval process.

“AM is a new and novel technology that requires special consideration from the FAA. When a certification project for an AM part is received by an FAA geographic Aircraft Certification Office (ACO), the assigned ACO engineer will work with the appropriate directorate from the AMNT to determine what unique considerations, if any, there are for certification of a specific AM part. The requirements will be defined and agreed by the ACO, the directorate, and the applicant,” explains a representative of the FAA, who did not wish to be named.

TSO APPROVALS

One of the challenges of the process is that – unlike traditionally manufactured materials – there is a lack



ABOVE: 3D PRINTING ENABLED AIRBUS AND AUTODESK TO CREATE A PARTITION BASED ON BIOLOGICAL FORMS RATHER THAN AEROSPACE CONVENTIONS

BELOW: AIRBUS SUBSIDIARY APWORKS 3D PRINTED THIS MOTORCYCLE, CLAIMED TO BE 30% LIGHTER THAN AN EQUIVALENT CONVENTIONAL MACHINE



of publicly available design value data. This technology is new territory, which means that unique standards must be set for each specific AM part.

“Changing the manufacturing process from traditional methods to AM is a design change and thus must be properly substantiated with an acceptable method of compliance to the TSO minimum performance standards,” the FAA tells us. “The FAA has not defined any special requirements for TSO approval of parts manufactured with 3D printers. Regardless of the manufacturing process, the TSO manufacturer must ensure each article produced meets all the applicable TSO requirements. Similar to the part certification process, the geographic ACO would work with the appropriate FAA AM focal point to determine what unique considerations, if any, there are for the approval of a specific AM part within a TSO. Furthermore, since the TSO is an article approval, there may be additional airworthiness requirements to receive an installation approval on an aviation product, e.g. aircraft, engine or propeller.”

However, for 3D-printed subcomponents, the approvals process is rolled into the TSO approval of the final assembly. “Regardless of the manufacturing process used and the extent of its use – entire article or subcomponent – the TSO manufacturer must ensure each article produced meets all the applicable TSO requirements,” the FAA representative explains.

BOEING'S GUINNESS RECORD

Boeing began its 3D-printing research in 1997, and has since introduced more than 50,000 additive manufactured parts to its products. The Boeing ecoDemonstrator, launched in 2015 through a special project with NASA and tourism company TUI Group, was used to test a 3D-printed aisle stand designed to reduce weight and waste. The stand was made using repurposed aerospace-grade carbon fiber generated as a by-product of production of the B787.

"As the application of additive manufacturing increases, we expect the technology will enable us to create high-performance products, raise production efficiency and improve workplace safety and first-time quality, and open up new design possibilities. For instance, we can minimize or eliminate the need for assembly by fabricating multipart assemblies as one piece and speed up production time," explains Boeing representative, Nate Hulings.

Boeing set a Guinness World Record for the largest solid 3D-printed item this August, with a 17.5ft-long, 5.5ft-wide and 1.5ft-tall wing trim and drill tool that weighs 1,650 lb and will be used to secure the B777X aircraft's composite wing skin for drilling and machining. The wing trim and drill tool would normally have taken around three months to manufacture, but as a 3D-printed part it was created in only 30 hours, according to Boeing.

"This is just an example of what we can do with additive manufacturing," states Leo Christodoulou, materials and manufacturing chief engineer at Boeing. "Additively manufactured tools will save energy, time, labor and production cost and are part of our overall strategy to apply 3D-printing technology in key production areas."

The tool was printed at the US Department of Energy's Oak Ridge National Laboratory (ORNL), a Boeing research partner. Boeing has collaborated with ORNL since 2014 to develop a week-long training program for its engineers, focused on 3D printing. More than 100 Boeing engineers have already completed the course.



The AM process also raises questions about the ownership and management of intellectual property related to parts developed in the supply chain.

During the Airbus Innovation days event in May, Airbus's digital transformation officer, Marc Fontaine, said that 3D-printed parts could simplify the parts management and delivery process, saving time and money.

"There may be very important changes in the future. For all aircraft families we are maintaining the capabilities of suppliers to produce the parts for our plants," Fontaine states. "Today you can store the parts digitally. That is very different in terms of economy. Of course, if you can print parts it changes the nature and logistics of the supply chain."

INTELLECTUAL PROPERTY

When asked about the IP implications of Airbus suppliers granting the drawings and technical information necessary to manufacture these parts remotely, Fontaine replies, "Rather than shipping parts around the world, there will be a split between the parts that are shipped and the parts that can be printed at a distance. That raises other interesting questions. How do you certify that the

"They don't want to have their IP locked into any type of unique vendor proposition"

file that you send from your design office, arriving in Singapore to be printed, is authentic? It's raising lots of questions that we're investigating, on cyber protection of these types of exchanges.

"What we see in most ALM partnerships is a very different approach to IP and to partnering. The approach of this industry for many years, and for very good reasons, has been to protect the IP and have long-running, very well-identified suppliers. We have to adapt to a world that is changing, because the technology driving several of these enablers is not currently in our industry. When we talk to these new partners, of course, they don't want to have their IP locked into any type of unique vendor selling proposition, so we have to find new ways.

"I must say that IP in procurement is a bit of a challenge for us, but it is part of our job as part of the Digital Transformation Office to make that possible.

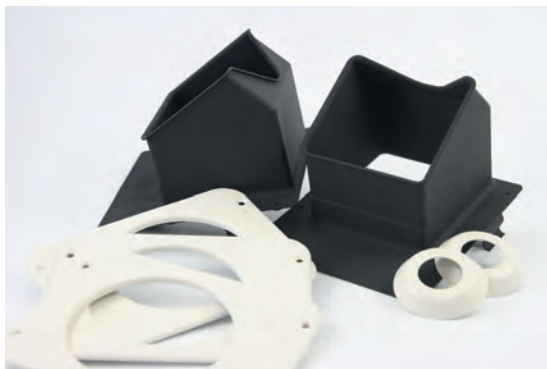
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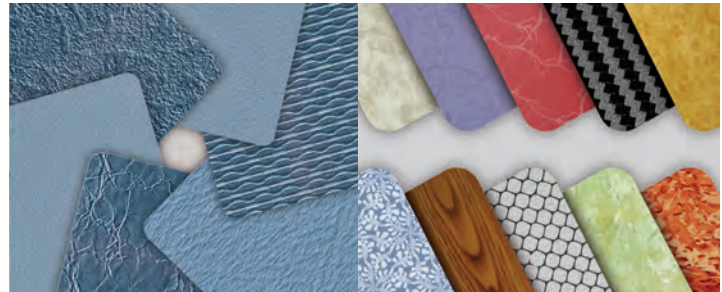


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“2,700 plastic additive manufactured parts have been introduced on the A350 XWB”

However, finding agreements is not very difficult because we're a big company in aerospace, and when companies have good technologies they want to team up with us. They are interested in teaming up with the big player in the sector and then they go more or less exclusively to that player. We adapt very well to that.”

BIONIC NETWORK

Airbus Group has begun using AM for tooling and prototyping of commercial aircraft parts, and 2,700 plastic AM parts have been introduced on the A350 XWB. Airbus is also making 3D-printed parts for the single-aisle A320neo and the A330/A310 family of aircraft.

The company expects that 3D-printed parts will reduce weight and inefficiencies while improving the strength of components. The AM process will also greatly reduce production time and waste, with an average of 5% waste material reportedly produced during the process.

BELOW: WHILE AIRBUS'S THOR IS A SMALL RESEARCH PROTOTYPE, ITS 90% 3D-PRINTED CONTENT MAKES IT A VALUABLE RESEARCH TOOL



AIRBUS THOR

Airbus has tested the aerodynamic limits of 3D printing with a pilotless mini-aircraft project named THOR (Testing High-tech Objectives in Reality). The 21kg aircraft was built from 90% 3D-printed parts, consisting of 60 structural segments joined together. These parts were printed using a plastic polyamide powder, over a period of seven weeks.



The part – built as a complete assembly using custom algorithms – mimics the organic cellular structure and growth of bones.

Airbus had set requirements that the partition be structurally sound and lightweight, as part of the push to reduce fuel costs by reducing the burden of cabin interiors. The finished product weighs 45% (30kg) less than current partition designs. Airbus estimates that such weight savings could reduce CO₂ emissions by 465,000 metric tons a year.

Airbus is exploring a number of natural structures to inspire new, lighter weight and sturdier aircraft parts. The strong honeycomb structure of the underside of water lilies, for example, has inspired wing flaps. Just as these structures make it possible for the thin water lily to support the weight of a small child, the channels in the wing-flap structure lets these lighter weight parts better distribute wind resistance.

Airbus's Bionic Network has also taken inspiration from the jaws of the angler fish, moray eel and sling-jaw wrasse to create new pivot bins with retractable lids.

"It isn't as simple as copying nature," Peter Sander, head of Emerging Technologies and Concepts at Airbus says of bionic 3D printing. "Successful bionics depends on establishing a deep understanding of natural materials and then working out how to apply that knowledge in the industrial world."



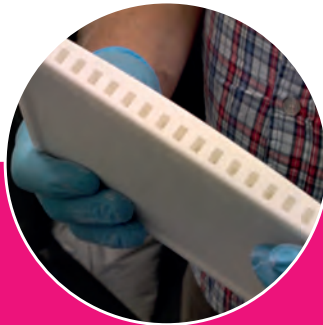
AIRBUS IS EXPERIMENTING WITH 3D-PRINTED PLASTIC AND METAL BRACKETS, AND PREDICTS AN ENTIRE 'BIONIC' FUSELAGE CONSTRUCTED FROM 3D-PRINTED COMPONENTS IN THE FUTURE

Aiding the development of these bionic parts is the evolution of generative design technology, which enables designers to develop thousands of alternative structural configurations using powerful cloud computing. Also key is the development of new raw materials used in the parts printing process.

One of these groundbreaking materials is Scalmalloy, which is used for metallic AM. It has strong mechanical properties, with high resistance to stress and stretching before breaking. The Airbus application is the first time Scalmalloy has been used on a large-scale in an aircraft component.

"Combining the benefits of metallic 3D printing with new materials like Scalmalloy can greatly expand the possibilities for modern components," states Joachim Zettler, managing director, Airbus APWorks. ⊗

"The Bionic Network isn't as simple as copying nature"



Airlines are also looking at ways in which AM can support fleet maintenance. In a collaboration with Auckland University of Technology, Air New Zealand developed 3D-printed fold-down cocktail trays for its Business Premiere seat this year.

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

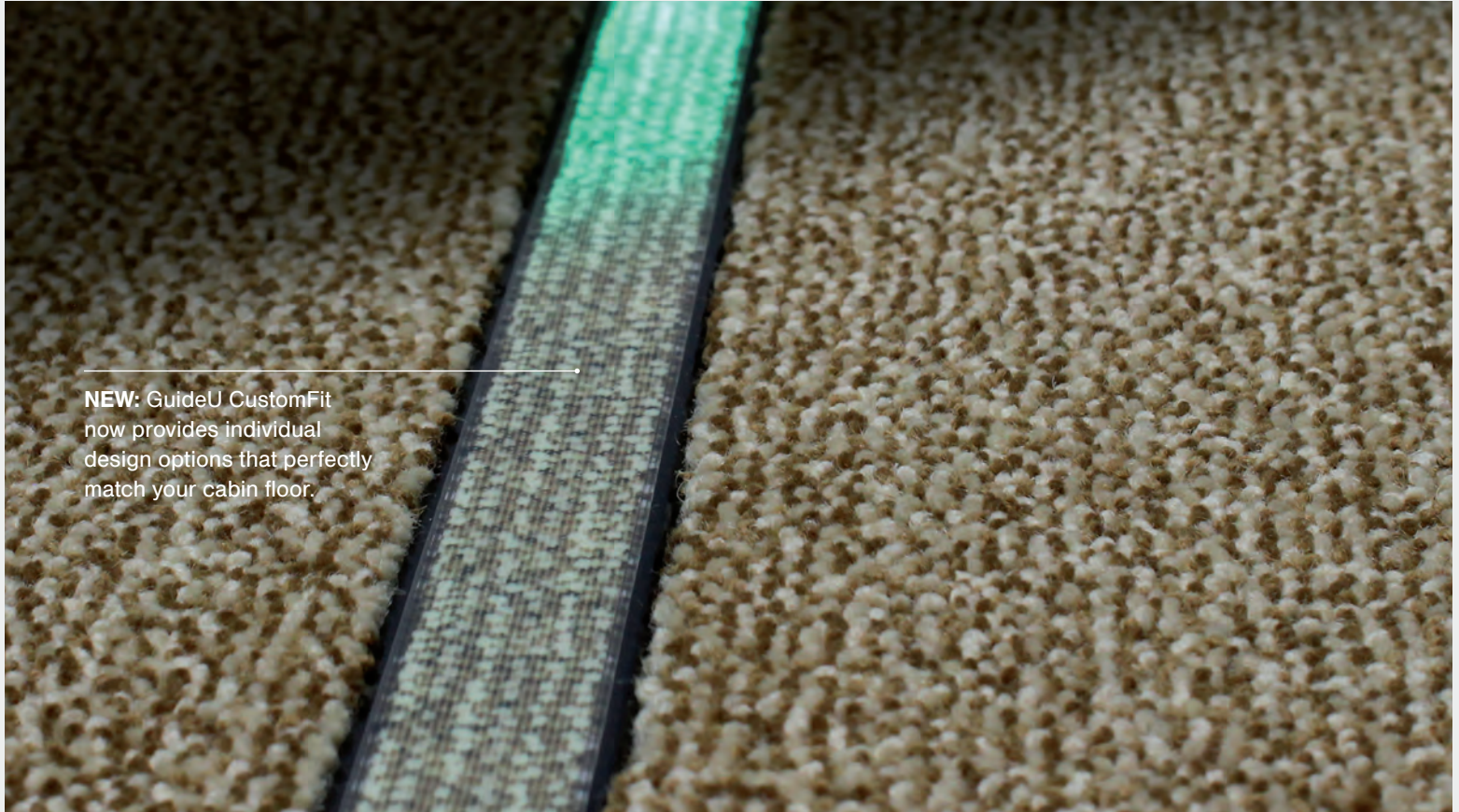
COCKTAIL HOUR

Air New Zealand's chief operations officer. "Not only can't we hold stock of every replacement part we might need, but 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."

The airline has said it will explore other 3D-printed parts that could be used in its cabins in the future.

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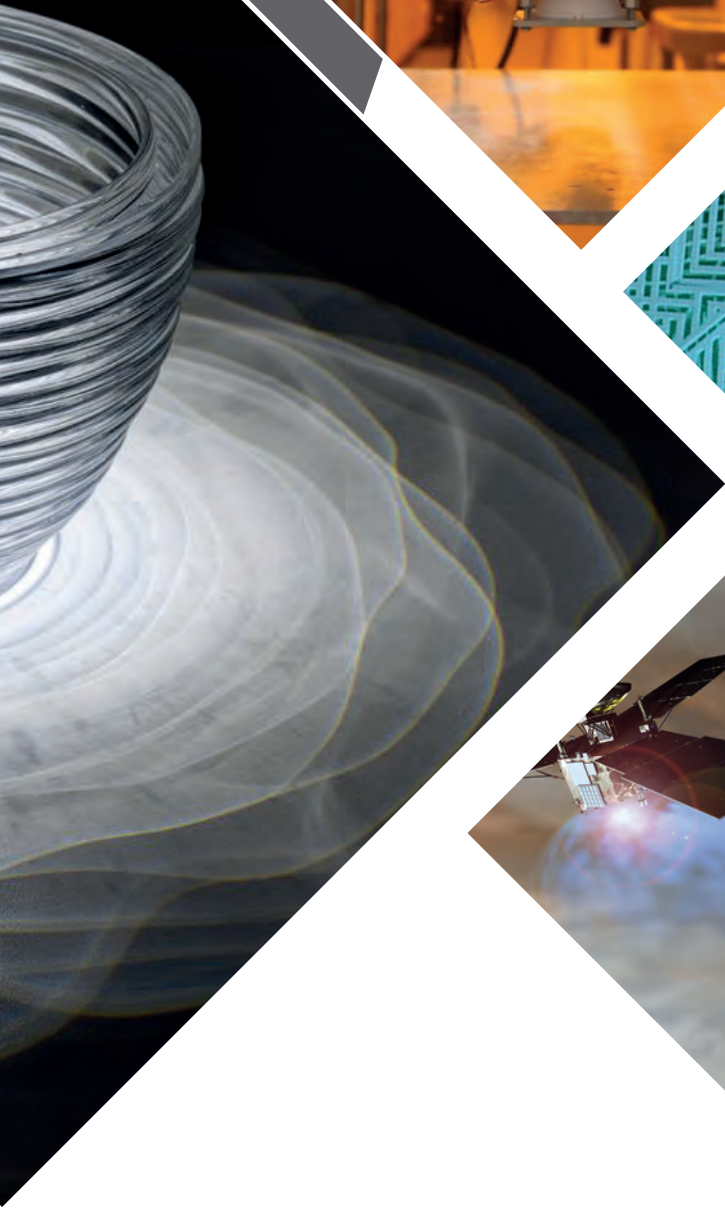
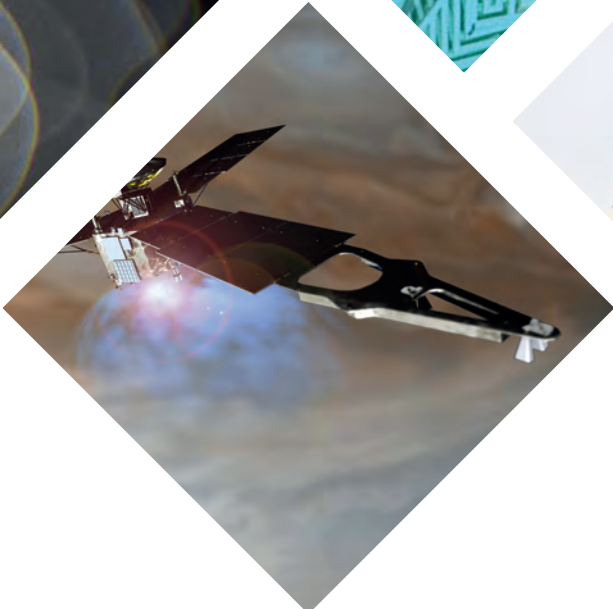
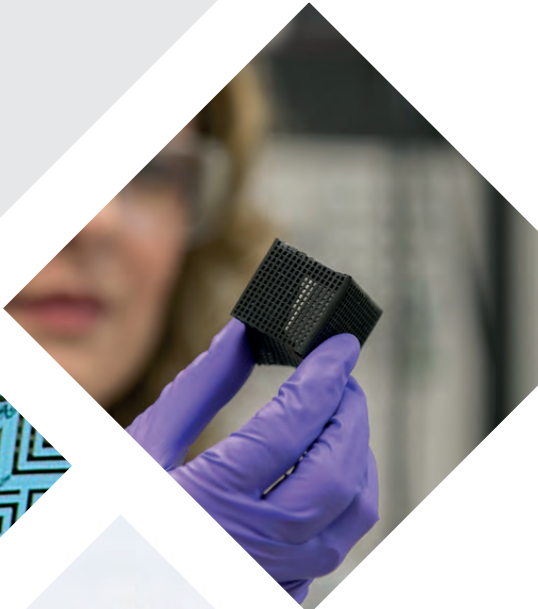
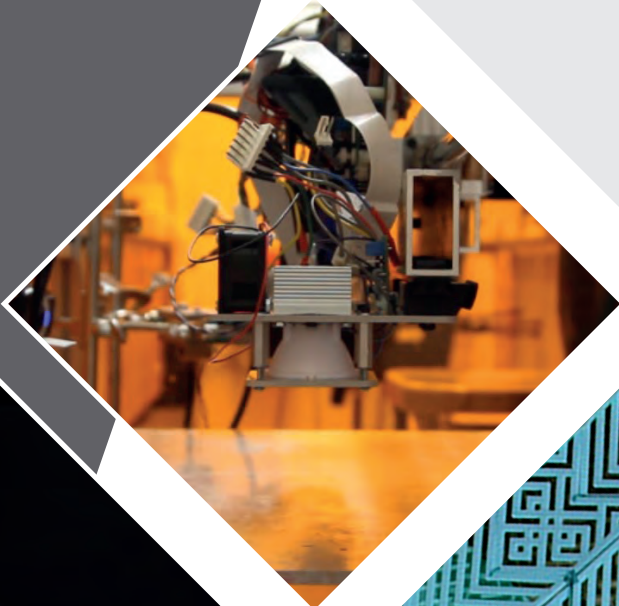


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ANOTHER DIMENSION

Additive layer manufacturing (ALM) in aerospace is still in its infancy, but research and development across the wider 3D printing industry could indicate how cabins will be manufactured in the future





SHORT-TERM GAINS

Using conventional manufacturing methods such as injection molding for short production series can be prohibitively expensive, while keeping large stocks of parts in low demand is deemed wasteful. ALM can solve this problem due to the minimal setup costs for short production cycles.

One company that has embraced ALM methods is 328 Design, a type certificate holder for Dornier, which often requires very short aftermarket production runs.

"3D printing lets us pick parts from a virtual shelf," says Volker Liedloff, team leader for interior engineering at 328 Design, which uses the services of ALM specialist Materialise. "We no longer run the risk of produced spare parts becoming obsolete too soon, or of keeping tools for parts with very low demand."

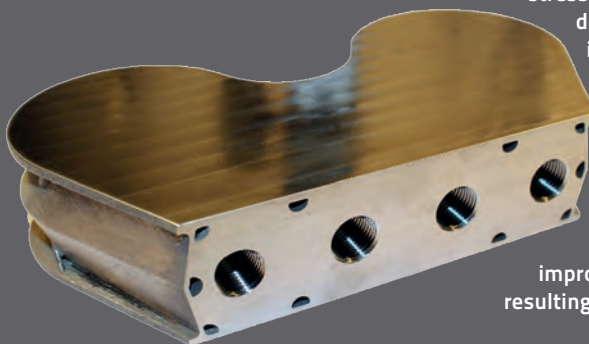
328 is also using the process as an opportunity to use alternative materials. The company was producing small parts in phenolic resin laminate, but was looking to switch to something more cost efficient.

As Steffen Kuhn, business development manager at Materialise explains, "When 328 needed a part at very short notice, we were able to produce it within the week."

After receiving the part design from 328, engineers at Materialise run checks for 3D printability and inspect values such as wall thicknesses. The parts are then laser-sintered at Materialise's Munich facility in a flame-retardant polyamide material in line with aerospace certifications, and culminates in production-certified 3D-printed parts that are ready to be installed in an aircraft.



A new company named Arevo has created a way to 3D print composite materials suitable for aircraft interiors



Space program

With each kilogram of a spacecraft costing around US\$20,000 to put into orbit, every gram saved when designing or engineering components can help make space a slightly more attainable frontier. But while weight optimization is crucial, it can't come at the expense of strength or performance.

ALM expert Materialise has worked with the engineering division of Atos, a digital services specialist, with the aim of reinventing a titanium insert that is widely used to transfer high mechanical loads in structures such as satellites. With a cleverly optimized design produced through metal 3D printing, the titanium inserts are just one-third the weight of the previous machined designs, with some improved properties added in.

The engineering teams decreased material use in the interior of the inserts by using advanced topology optimization and lattice structured design techniques – effectively hollowing them out – to reduce the insert's mass from 1,454g to 500g.

The inserts were co-cured with the composite structure sandwich panels, with loads transferred to the panels through an adhesive.

As well as weight reduction, the team also resolved thermoelastic stress issues with the original design.

As these inserts are installed during the curing of carbon fiber-reinforced polymers, they are subject to thermoelastic stresses. The optimized design of the inserts has reduced vulnerability to these stresses and

improved load distribution, resulting in an increased life.



What comes after 3D? 4D!

A team of researchers at the Lawrence Livermore National Laboratory (LLNL) in California has developed a way to 3D print structures that can change shape when exposed to heat or electricity, creating a fourth dimension of folding or unfolding effects.

The team has fabricated the micro-architected structures from a conductive, environmentally responsive polymer ink developed in-house, and they claim this is the first time that 3D printing and folding methods have been combined with conductive smart materials to build complex structures.

The primary forms are created using an ink made from soybean oil, with co-polymers and carbon nanofibers added, and a second, temporary shape is then programmed in at an engineered temperature, determined by the chemical composition.

When ambient heat is introduced, or the material is heated using an electrical current, the shape-morphing effect is induced, making the part's temporary shape revert back to the original. Put simply, a bent conductive device could morph to a straight device when heat is applied.

Ultimately, the materials can be used to create extremely complex parts. For example, in the aerospace sector the technology could be of value in solar arrays, antennas that unfold, flexible circuits or robotic devices.

As LLNL staff scientist James Lewicki adds, "It opens up a whole new property set. If you can print with these polymer composites you can build things and electrically activate them to unfold. Instead of a dumb lump, you have this responsive material."



NATURAL SELECTION

When scientists are seeking design inspiration, they often turn to the animal kingdom. Take spiders and caterpillars, for example, which create impressive structures from woven threads. These creatures produce a liquid that polymerizes into a strong thread as soon as it is exposed to the air outside their bodies, and they use it to form sturdy webs and cocoons.

These structures provided the inspiration for scientists at automation technology company Festo to develop the 3D Cocooner, as part of its Bionic Learning Network, a device that spins filigree figures and lightweight structures from a fiberglass thread. The spinneret is precisely controlled by a handling system, and the sticky fiberglass threads are laminated with UV-hardening resin and joined to form complex structures.

The major difference between the 3D Cocooner and conventional ALM processes is that these structures are not built up in layers on a surface, but instead created freely in three-dimensional space, enabling new strong, elegant and lightweight structures.

Customization made simple

Ideas such as Fab Forms could enable inexpensive experimentation with cabin designs

Until ALM becomes more commonplace, design houses embarking on their first projects may find the design process to be difficult and time consuming. Using CAD, modifying a design involves changing numerical values in input fields and then waiting for as long as a minute while the program recalculates the geometry.

Once the design is finalized, it has to be tested for compliance with the printer specifications using simulation software, as well as for structural stability and integrity. Those tests can take anywhere from minutes to hours to complete, and they

need to be run every time the design changes.

Researchers at MIT's Computer Science and Artificial Intelligence Laboratory and the Interdisciplinary Center Herzliya in Israel are working to make this work a little easier by developing a system that automatically turns CAD files into visual models that users can modify in real time.

For example, for cabin products, application could be limited to simple customization options such as color, finish or size, with customers able to make adjustments to a stock design over the internet simply by moving sliders on a web page and pressing the print button when ready, sending the design to the supplier's 3D printer.

So how does it work? The system, dubbed Fab Forms, begins with a design created by a skilled CAD user. It then sweeps through a wide range of values relating to the design's parameters, calculates the resulting geometries and stores them in a database.

For each of those geometries, the system runs a battery of tests, specified by the designer, and again stores the results. The whole process would take hundreds of hours on a single

computer, but in their experiments the researchers distributed the tasks among servers in the cloud, making the process considerably faster.

Finally, the system generates a user interface consisting of a central window, which displays a 3D model of an object, and slider controls that can be used to vary the parameters of the object's design. The system automatically weeds out all the parameter values that lead to unprintable or unstable designs, restricting slider movement to valid design parameters.

Moving one of the sliders – to change the width of an armrest or meal tray, for example – sweeps through visual depictions of the associated geometries, presenting in real time what would take hours to calculate with a CAD program, with a sample density high enough for the process to seem continuous to the user.

If a user wants a value for a parameter that falls between two samples stored in the database, the system can call up the CAD program, calculate the associated geometry and run tests. That might take several minutes, but at that point the user will have a good idea of how the final design will look.



PRINTED UNIFORMS?

3D-printing technology could offer exciting branding opportunities in crew uniform design, offering unlimited possibilities for customization and enabling designers to create unusual decorations and accessories that couldn't be manufactured in traditional ways. Elements that could take weeks to create using traditional craft techniques can be made in a fraction of the time using 3D printing, enabling integrated branding in clothing, or even custom airline jewelry. Being able to cost-effectively

create limited runs of uniforms could enable airlines to have a little fun, printing custom uniforms for special or seasonal events – Halloween or a route launch, for example.

The possibilities for the technology have been demonstrated by Macedonian designer Irina Tosheva, who has created a colorful fashion collection influenced by Balkan traditions, all decorated and paired with accessories and jewelry created entirely using 3D-printing technology.





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MIT has also developed a method of 3D printing soft materials with reconfigurable surface textures

Fab ideas

Researchers at MIT's Computer Science and Artificial Intelligence Lab (CSAIL) believe they have found a way to make a low-cost, user-friendly 3D printer that can print an unprecedented 10 different materials at once using 3D scanning techniques.

Delivering resolution at the level of 40 microns – less than half the width of a human hair – the MultiFab system features an integrated machine vision system that offers two key advantages.

First, the system can self-calibrate and self-correct, meaning users do not have to do the fine-tuning themselves. For each layer of the design, the system's feedback loop 3D scans and detects errors and then generates 'correction masks' for a perfect finish.

Second, users can embed complex components like circuits and sensors directly onto the body of an object, meaning that it can produce a finished product, including any moving parts, in a single process.

"The platform opens up new possibilities for manufacturing, giving researchers and hobbyists alike the power to create objects that have previously been difficult or even impossible to print," explains Javier Ramos, a research engineer at CSAIL working on the project.

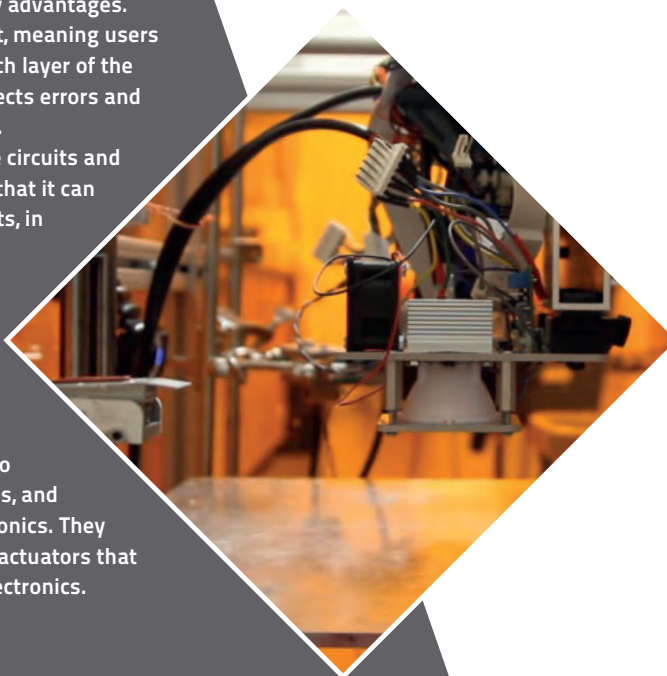
During development, the team has used MultiFab to print everything from smartphone cases to LED lenses, and they envision an array of future applications in electronics. They also plan to experiment with embedding motors and actuators that would make it possible to 3D print more advanced electronics.

OUT OF THIS WORLD

Lockheed Martin is pioneering new methods for additive manufacturing at its Advanced Technology Center (ATC) in California to discover faster, smarter ways to manufacture spacecraft.

Indeed the company developed the Juno spacecraft, which is cruising toward Jupiter to help scientists study the planet. Lockheed Martin clearly has faith in 3D printing, as the craft is traveling 1.7 billion miles with 3D-printed titanium brackets on board. The brackets are used to attach the waveguides, rectangular pipes used for conducting radio frequency signals between spacecraft components.

Once printed, the brackets were refined by smoothing out the surface, then rigorously tested before installation. Even the slightest particle disturbance had to be minimized for safe space flight, but these 3D-printed components passed the tests and are reported to be performing well.



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Printing with wood

Most 3D printing research focuses on fossil-based plastics and metals, but how about something more organic? A group of researchers at Chalmers University of Technology in Sweden has reported that they have successfully 3D bioprinted and dried three-dimensional objects made from cellulose, and even added carbon nanotubes to make the material electrically conductive.

Paul Gatenholm, professor of biopolymer technology at Chalmers and the leader of the research group, explains, "Cellulose is an unlimited renewable commodity that is completely biodegradable, and manufacturing using raw material that comes in essence from wood, means binding carbon dioxide that would otherwise end up in the atmosphere.

The difficulty in using cellulose in additive manufacturing is that it does not melt when heated, rendering the printers and processes designed for 3D printing plastics and metals unsuitable.

The Chalmers researchers solved this problem by mixing cellulose nanofibrils in a hydrogel consisting of 95-99% water. The gel could then in turn be dispensed into the researchers' 3D bioprinter.

The printed gel-like objects were then freeze-dried in a special process so they retained their three-dimensional shape, and the cellulose gel was mixed with carbon nanotubes to create electrically conductive ink after drying. Carbon nanotubes conduct electricity, and another project at Chalmers is looking at developing carbon nanotubes using wood.

Using the two gels together, one conductive and one non-conductive, and controlling the drying process, three-dimensional circuits can be produced, with the resolution increasing greatly on drying.

The two gels together provide a basis for the possible development of a wide range of products made by cellulose with in-built electric currents, such as textiles that convert body heat to electricity.

The Brazilian Air Force is implementing 3D printing to evaluate the viability of new aircraft parts



PRINTED GLASS

A first of its kind optically transparent glass printing process has been created in a collaboration between MIT and the Wyss Institute at Harvard University. Named G3DP, the project seeks to exploit the tunability enabled by 3D printing, experimenting with the geometrical and optical variations driven by form, transparency and color variation, and limiting or controlling light transmission, reflection and refraction.

The G3DP platform is based on a dual heated chamber concept, with the upper chamber acting as a kiln cartridge while the lower chamber serves to anneal the structures. The kiln cartridge operates at approximately 1,038°C and can contain sufficient material to build a single architectural component. The molten material is then funneled through an alumina-zircon-silica nozzle.

The team is not alone in working on 3D-printed glass, as 3D-printing company Micron3DP has invented a new way to 3D print glass in a hot, liquid form. The company has successfully printed 'soft' glass at 850°C, as well as borosilicate glass at a melting temperature of 1,640°C.





BIG THINKING

We've seen small 3D-printed parts such as cocktail tables enter the aircraft cabin (see p36), but how about thinking a little bigger – or even a lot bigger.

Stratasys and Boeing have been working on the Infinite-Build 3D Demonstrator, designed to address the requirements of the aerospace industry for large, lightweight, thermoplastic parts with repeatable mechanical properties.

The demonstrator rethinks the traditional 3D printer concept with an 'infinite-build' approach, which prints on a vertical plane for practically unlimited part size build, and Boeing is using the machine to explore the production of low-volume, lightweight parts.

"We are always looking for ways to reduce the cost and weight of aircraft structures, and to reduce the time it takes to prototype and test new tools and products so that we can provide them to customers in a more affordable and rapid manner," says Darryl Davis, president of Boeing Phantom Works. "The Infinite-Build 3D Demonstrator enables products to be made at a much larger and potentially unlimited length, offering us a breakthrough tool to add to our robust additive manufacturing processes."

Airbus is also trialling the use of humanoid robots on its assembly line in Puerto Real, Spain

Save a ton in weight



APWorks, a subsidiary of Airbus Group that studies production processes such as metallic 3D printing, plans to make life a little simpler for aerospace companies seeking to apply 3D-printing processes to reduce aircraft weight. APWorks has teamed up with enterprise application software company SAP to create a bionics network that connects 3D-printing experts and end users.

Initial applications will be small components such as lightweight armrests and brackets.

The co-innovation agreement between SAP and APWorks plans to address issues such as digitalization and simplification of the production part approval process; screening and validating of parts produced using 3D-printing processes; designing and redesigning parts or

systems to optimize them for on-demand manufacturing and 3D printing; and acceleration of and standardization of the processes required for certifying the 3D-printed parts.

Joachim Zettler, CEO of APWorks, believes that if the maximum possible number of components on an A350 were 3D printed, it would reduce the weight of the aircraft by nearly a ton.

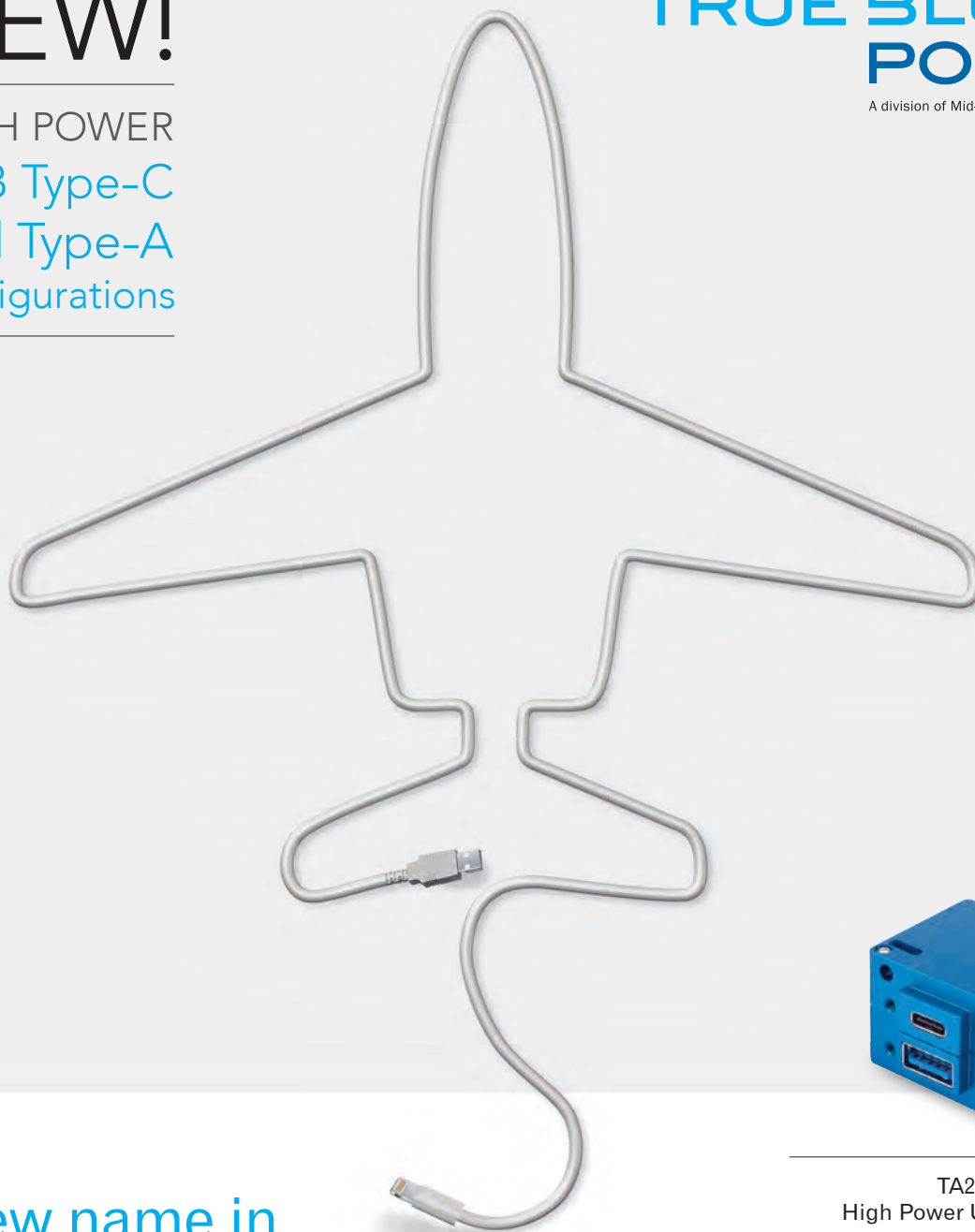
"Innovation in on-demand 3D printing is revolutionizing traditional manufacturing," states Torsten Welte, global head of aerospace at SAP. "In the next few years 3D printing will be widely adopted across manufacturing industries. The aerospace and defense markets will transform digitally to strive to achieve near-zero unplanned downtime on commercial aircraft, as well as supporting high production turnaround at a lower cost. What makes 3D printing most attractive in aerospace is the removal of many costs associated with traditional manufacturing, such as stocking inventory. Users are able to print the parts they need, as needed." ✕

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It was time to look at what kind of company we want Finnair to be

FINNAIR'S CEO, PEKKA VAURAMO, HAS FOUND THAT EXPERIENCE AND WISE SPENDING IS BETTER FOR PROFITS THAN CONSTANT COST CUTTING

Words by Marisa Garcia

Reducing costs is less likely to create growth for an airline than securing experience. Indeed for Finnair CEO Pekka Vauramo, moving away from an exclusively cost-cutting mentality and developing a strong brand identity has helped the company meet its financial objectives and ensure growth.

"I joined Finnair in June 2013, when we were in the middle of cost-cutting programs. Cost-cutting programs for us meant that we needed to reduce our total operating costs by 10%. The airline was halfway through executing that when I joined in 2013, so we had another 5% to go.

"Very soon after I joined I realized that an airline does not become a great airline just by cutting costs. Of course, I was new in the aviation industry [see p53 for a short biography] and I was listening to what many external parties such as bankers, analysts and consultants had to say. At times I felt, 'Can this be right? The valuation of an airline depends only on how big or how extensive a cost-cutting program they have announced?' I'm not convinced that it can be the one and only way to look at how airlines perform," Vauramo says.

"Cost-cutting programs were considered more important than how the airline was growing, how it was developing, how it was looking after its customers, or, at the end of the day, how it performed financially, other

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than in terms of cost reductions. I was fairly confused about this, but we needed to finish the program, which we did at the end of 2014. Then it was time, after so many years of just focusing on cutting costs, to look to the future at what kind of company we want Finnair to be.”

REDISCOVERING THE BRAND

Raising that question of what kind of airline Finnair should be led on to an internal re-discovery and re-definition of Finnair’s identity, which would ultimately shape the company’s strategy for products and services.

“We engaged our people in our conversation. We kicked off a cultural journey within Finnair and the starting question was ‘What type of company do we all want to work for?’” Vauramo says.

ABOVE: FINNAIR OPTED FOR THE ZODIAC CIRRUS III CATALOG SEAT FOR ITS A350 BUSINESS CLASS

RIGHT: CABIN APPEARANCE CAN BE UPDATED BY SWAPPING THE EYE-CATCHING SOFT ELEMENTS, DESIGNED WITH MARIMEKKO

“Good service is an important element of making money”



PEKKA PROFILE

Finnair’s board of directors appointed Pekka Vauramo as CEO on June 1, 2013. Vauramo had spent the previous three years based in Hong Kong as COO of the MacGregor marine cargo business division of Cargotec, a Finnish cargo and load handling company. Vauramo served in various positions at Cargotec following his joining in 2007, including head of MacGregor and deputy CEO of Cargotec, as well as head of the Kalmar container handling business unit. Vauramo started his managerial career at Sandvik, a Swedish mining and construction company, where he worked from 1985 to 2007. Vauramo, age 58, holds a MSc degree in mining from Helsinki University of Technology.

“Elevating the customer experience became a key driver,” he adds. “In my previous business experience, good service has always been a very important element of making money. Nobody likes bad service – it’s a no-brainer.”

CHECKING OUT HOTELS

Vauramo contrasts airline strategy with hotel industry strategy, in terms of building a resilient business.

“The hotel industry has been very successful, compared with aviation. They have not commoditized their product. They have really clearly differentiated the product,” he says. “We have educated our customers that the only thing they should look at when they travel with an airline is the price of the ticket. We have educated them too successfully, I would say. We need to educate the market away from that type of thinking.”

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Vauramo also takes inspiration from how global mega-brands define themselves, find their unique qualities and advantages, and build ties to their customer base. “These are the ones we really consider when we are designing our future services,” says Vauramo.

CULTURAL CONSIDERATIONS

For Finnair, a key part of its growth strategy has been to capitalize on Helsinki’s advantageous location as an efficient connector to Asia. But although the airline has hinged its growth on attracting more Asian travelers, it had to decide how to best represent itself in this different cultural context.

“We thought, since we are growing in Asia, perhaps we should become more like an Asian airline in terms of our service. Or should we be a little more American, or European, or should we just be Finns? But we thought that we would not become Asian. We don’t know that culture, even though we have a lot of Asian crew.”

The airline ultimately decided that it wanted to create a feeling of the Nordic region for passengers. As Vauramo says, “This shows in many different elements of what we do. You see it in the light colors in our aircraft and lounges, in our meals – in our entire program. We also like to promote design and products that are made in the Nordics.”

The recently launched A350 has become the signature and the flagship of the airline’s growing fleet, but

ABOVE AND ABOVE RIGHT: THE A350 IS FITTED WITH ZODIAC Z300 SLIMLINE SEATS, CONFIGURED 3-3-3 AT A 31IN PITCH IN ECONOMY, AND 35IN IN ECONOMY COMFORT

Vauramo explains that providing a uniquely Nordic experience goes beyond the aircraft type, with the neutral color palette introduced across the fleet allowing Finnair a certain flexibility in terms of design.

“We add colors with elements that we bring in, such as pillows and blankets,” Vauramo says. “The best way to keep cabin interiors fresh is to just change the little things, not the difficult major things.”

SERVICE IS KEY

In the end, however, Vauramo believes that product alone cannot build the brand.

“That’s the hardware side, and anyone can put commercially available hardware on board an aircraft.

SPACE ALIVE

Key factors in the design of Finnair cabins and lounges are fresh Nordic design and use of the Space Alive concept, developed by Helsinki-based studio, dSign Vertti Kivi. The concept uses lighting and physical elements to transform the atmosphere and functions of a space throughout a period of time such as a day or the duration of a flight.

Changes in the atmosphere on board Finnair’s A350s are achieved through creative use of the dynamic LED system, with moods changing as the flight progresses. The ambient lighting can be programmed to gradually recall 24 different skylscapes as the flight progresses, such as sunrise or sunset and cloud formations, which eases customers on long-haul flights into new time zones, destinations and seasons.

But what really makes the difference is the customer encounters,” he says.

“The average flight attendant or customer service representative at the airport has on average 20,000 customer encounters per year. That’s a lot. You want to differentiate your service and provide a good experience that makes people come back to you. It’s not acceptable to provide a good experience for 51% of your customers, because then you have failed 49% of them. The rate of success needs to be very high. Therefore, the motivation of our people – and how we treat our people – is a key element of our strategy. We want our people to be there and provide good service and also engage our personnel to create that feeling of a good and positive experience on board the aircraft.”

KEEP IT SIMPLE

Other concerns for Finnair include simplifying the journey through digitalization, and accommodating the needs of an aging population.

“We have so many tourists coming from Asia, Japan especially, to our part of the world. Some of these people may be 80 years old, some 90. These people are used to a very high level of service, and require our services. So we cannot simply rely on digitization,” Vauramo says.

In important ways, Vauramo suggests, making the journey easier on customers can help cut costs.

“We look at what is happening throughout the journey in detail and identify opportunities where we can

BERRY GOOD

Presenting a unique Nordic brand to the world is not just about expensive aircraft and cabin product; it also involves smaller signature elements.

“The Nordic people are proud of their local ingredients. For example, last year we introduced blueberry juice. Wild blueberries grow all over Finland, so we started serving blueberry juice, and today I think we’ve served more than a million liters on board our airplanes. These kinds of small things connect the airline to the Nordic experience,” says Vauramo.

“Maintaining cost discipline will continue to be important, but the future demands more”

innovate, and where we can make things easier and reduce passengers’ stress levels. If we can get passengers on board with low stress levels, they are ready to have a pleasant journey. Serving this kind of customer is very different compared with someone who is disappointed or stressed about something that has gone wrong. We all know the level of effort it takes to turn around this kind of customer,” he says.

BELOW: FINNAIR’S A350 CABINS ARE FINISHED IN NEUTRAL TONES TO REFLECT CLEAN NORDIC DESIGN AND TO ACT AS A BACKDROP TO THE SOPHISTICATED LIGHTING EFFECTS



THE BOTTOM LINE

Vauramo has balanced Finnair between the narrow focus of bankers on cost reductions and the needs of customers for more investment. In this way, he has helped build the top line, ensuring revenue growth. He is keen to emphasize that maintaining cost discipline will continue to be important, but the future demands more.

“Yes, we need to look and make sure that our cost level isn’t too high. But after that we have to grow the top line. The airline business is growing. People are traveling more and more and that’s an opportunity that we have to take,” Vauramo says. “We are growing at around 8% now, and next year we will likely see more than 10% growth at Finnair. That growth opens up many opportunities.”

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TWISTED LOGIC

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Words by Dr Peter Vink, TU Delft, Netherlands

When it comes to aircraft seating, one size has to fit all, but does it really fit all? Most aircraft seats have a curve in the backrest, but the question of whether this curve follows the shape of the human back is difficult to answer. An aircraft seat is used by a large variety of passengers of different sizes and shapes who need safe and easy ingress and egress, and once in place need the seat to support them as they engage in various activities during a flight such as eating, sleeping and watching IFE. Add in the safety

requirements that have to be met and it is clear to see why an aircraft seat is one of the most complex types of seat to design and engineer.

STIMULATING MOVEMENT

The ideal backrest curve for an aircraft seat does not exist. A growing number of scientists in the field of musculoskeletal injuries are of the opinion that it is more important to passengers to be able to vary their seated posture than to design seating for the ideal static posture.



FIGURE 1: ESTIMATION OF THE BACKREST CURVE IN AN AIRCRAFT SEAT

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FIGURE 2: ESTIMATION OF THE BACKREST CURVE IN AN ECONOMY CLASS AIRCRAFT SEAT

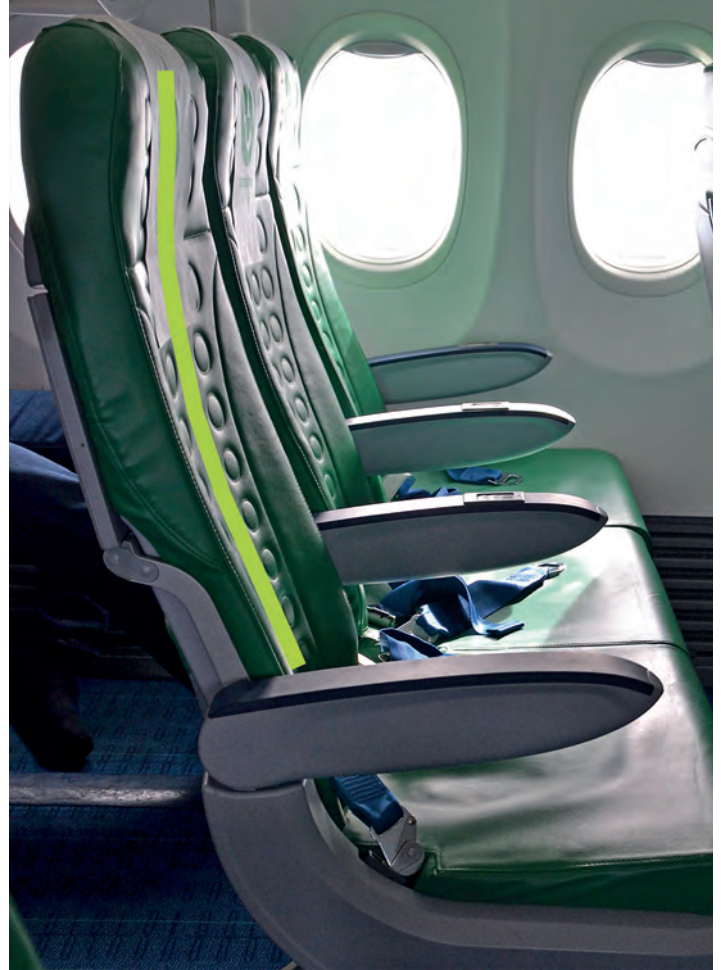
“Comfort and support were considerably better in a dynamic configuration”

With office seating, variation is enabled by having variations in tasks during the day, and having a movable seat pan and backrest. This variation of posture is hard to achieve in economy class aircraft seating, and especially for long-haul travel it is important for passengers to be able to vary their posture in order to prevent discomfort.

For business class seats there is a new opportunity. Earlier this year, Sigrid Van Veen, an integrated product design graduate from TU Delft now working for BMW, developed a new means of posture variation in a car seat by devising a seat that slowly moves. Posture variation is achieved by continuously varying the angle of the seat pan and backrest by 2° and 1.5°, respectively.

In an experiment, 21 participants sat on both the moving seat and a static seat. Results showed that comfort and support were considerably better in the dynamic configuration, with participants feeling notably more active, energetic, stimulated, pleasantly surprised, pleased, comfortable, accepting and calm.

Transferring this knowledge achieved in a BMW luxury car seat to a business or



premium class aircraft seat is certainly a possibility worth studying.

3D SCANNING THE BACKREST

The backrest of an aircraft seat should be designed so that the occupant's body posture can be varied, and their seated activities facilitated. Recently, some studies at TU Delft have evaluated the form of the human back and buttocks using 3D scanning technology. The scans were made using a variety of human sizes in various postures, including sleeping, eating, reading, using a smartphone or a laptop, and chatting. The difficulty of scanning the buttocks and back is that the seat is blocking the contour.

At TU Delft, some attempts have been made to position people in a kind of hammock in order to record the contour. However, the results were not comparable to the contour found while sitting with a foam buttock

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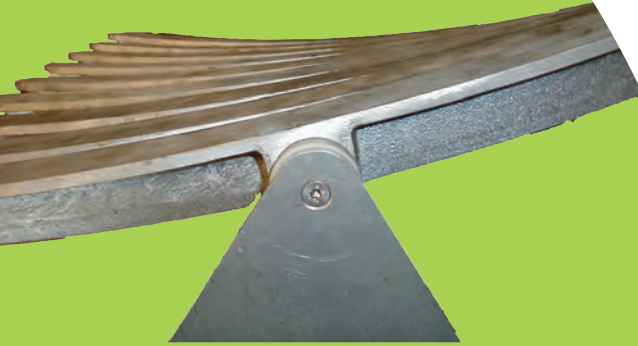
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FIGURE 3: RECORDING THE HUMAN BACK CONTOUR USING A KYPHOMETER



DO THE TWIST

In recognition that humans twist their bodies to get comfortable rather than simply reclining, the team at the Factorydesign studio has devised the Twister seat, a concept conceived specifically for long-haul comfort, with a mechanism that mimics the shape of the human spine.

A series of ribs run along the vertical 'backbone' section and across the seat pan, and as the occupant's weight shifts, so do the ribs, to maintain a shape that is comfortable and ergonomically sound.

"From your shoulders to your thighs, the seat follows your profile as you move," explains Adam White, the inventor of the design, and joint creative director of the studio. White devised the design during a 14-hour flight in economy class from Japan to the UK, when he felt that the 5in of available seat recline didn't add a great deal of comfort.

With the Twister design, passengers could lean in one direction or curl up in another, and once the desired position is found, the seat is held in that position with the press of a control button. With another press of the control button, the seat returns to the neutral TTOL position.

According to Factorydesign, because the Twister seat distributes body weight more evenly than conventional economy class seats, it helps avoid deep vein thrombosis. "You wouldn't get a pressure point under the thigh, which would be a significant health benefit," states White.

support and seat support for the back. A new approach was hence developed by BMW, TU Munich and TU Delft in which people are positioned in a rescue vacuum mattress. This vacuum mattress consists of small polystyrene balls, which settle around the body contour like a bean bag. The form is held in place by air suction and remains visible in the mattress after the person has left the seat. This form is then scanned.

This method has since been applied to a car seat, an economy class aircraft seat and a business class aircraft seat. Overlaying the scans of people with different sizes performing different tasks is a complex computational task, but has been successfully applied in these three cases. These three studies all indicate that seats could be more lightweight, without compromising the comfort of heavier traditional seats.

KYPHOMETRY CREATES SHAPE

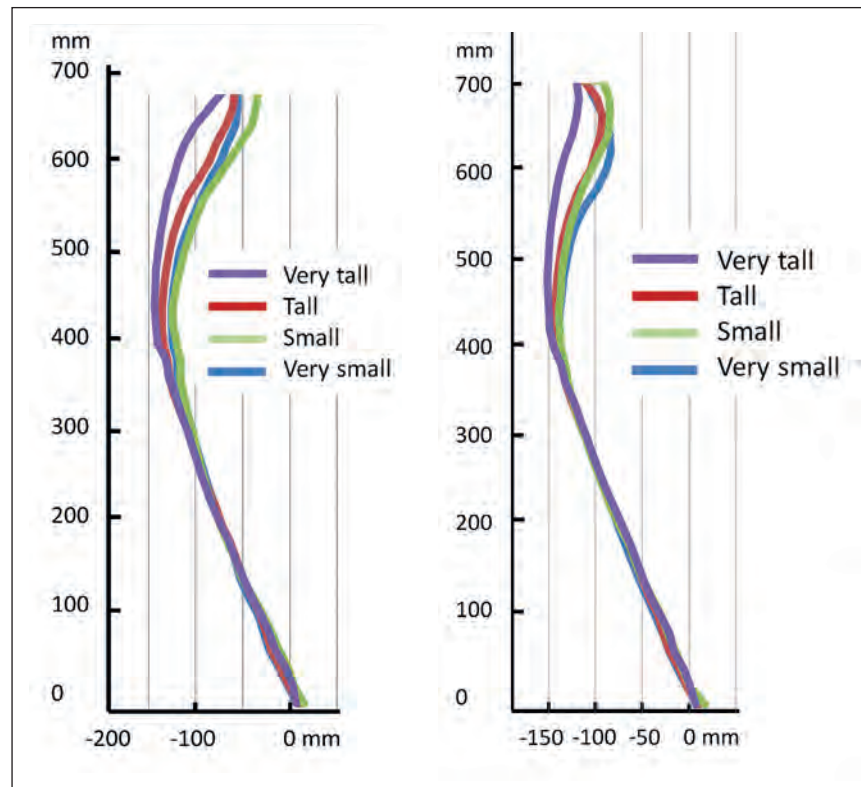
Another method for studying human contour in an aircraft seat was developed by a TU Delft team, who recorded the back contour of an aircraft seat (31in pitch, 6.5° seat pan angle, 106.5° backrest angle) of 46 participants (average body length 1,751mm [5ft 7in]) using a kypnometer while working on a laptop (sitting a little forward and bent back) and while watching IFE (an upright position).

The kypnometer recording is shown in Figure 3. The points of the kypnometer were recorded digitally, and the curves of the human back are shown in these two positions (laptop and IFE) in Figures 4 and 5.

The 46 subjects were divided in four groups of 11 or 12 participants. The very short group (11 participants) had an average length from their buttocks to the tops of their heads of 866mm (standard deviation = 50.5), the

FIGURE 4 (RIGHT): THE BACK CONTOUR IN AN AIRCRAFT SEAT OF FOUR GROUPS WITH DIFFERENT ANTHROPOMETRICS WHILE USING A LAPTOP

FIGURE 5 (FAR RIGHT): THE BACK CONTOUR IN AN AIRCRAFT SEAT OF FOUR GROUPS WITH DIFFERENT ANTHROPOMETRICS WHILE WATCHING IFE (AT EYE LEVEL)



“It is better to have space for smaller passengers than for taller passengers to be forced into a bent position”

short (12 people) 908mm (SD = 9.4), the long (12 people) 937mm (SD = 10.8) and very long (11 people) 984mm (SD = 19.3). In many cases the curve of the very tall group has been used by the team for backrest design as the lower part is similar for all groups. There is no significant difference in curvature for the first 400mm above the seat pan. Additionally, for the upper part of the seat, it is better to have space for the smaller passengers than for tall passengers to be forced into a bent position.

Some engineers and designers may be used to designing for the average-sized person. That is sometimes a good solution, but in this case it is better to create the space for the taller passengers. It is also not wise to design a bed for the average person length or a door opening for the P50, as 50% of people will have to bend forward to go through the door opening or will have a painful sleeping experience. This curvature (of the tallest group) is used in, for instance, the backrest of the new Southwest Airlines seats, and soon passengers will experience a curve that fits well for most activities.

Perhaps seat designers can use the curvature shown in Figures 4 and 5 to optimize forms. It should be done with care as this curvature is recorded in a specific configuration (31in pitch, 6.5° seat pan angle, 106.5° backrest angle). This curvature is also recorded in the middle of the backrest in the vertical plane, and ideally the curvatures in the other planes are also used. 3D scans could be helpful in determining curves in other planes.

Further studies at TU Delft have found that completely following the human body contour at the shoulder level is not ideal, and that offering free shoulder space of at least 60mm reduces back muscle activity. In practice, the free shoulder space is also seen as the space that creates the freedom to rotate the upper part of the body, which is important for passenger comfort while flying. ✕

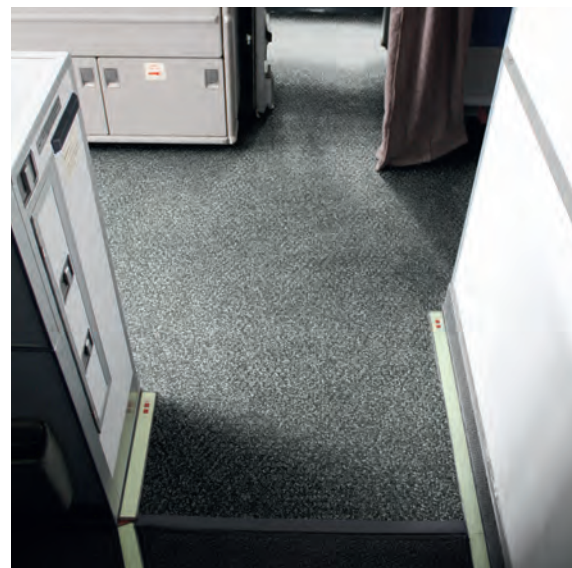
ABOUT THE AUTHOR

Prof. Dr Peter Vink is a professor of environmental ergonomics and head of the design engineering department at Delft University of Technology in the Netherlands. He has written more than 200 papers and books in the field of comfort, performance and design of aircraft interiors, and is releasing a new book entitled *Vehicle seat comfort and design, with special attention for the aircraft seat.*



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THE NEXT BIG THING IN INFLIGHT CONNECTIVITY COULD BE ENABLED BY CO-OPTING EXISTING LED LIGHT SOURCES TO TRANSMIT DATA THROUGHOUT THE CABIN

Words by James Gordon. Illustration by Karine Faou

fantastic

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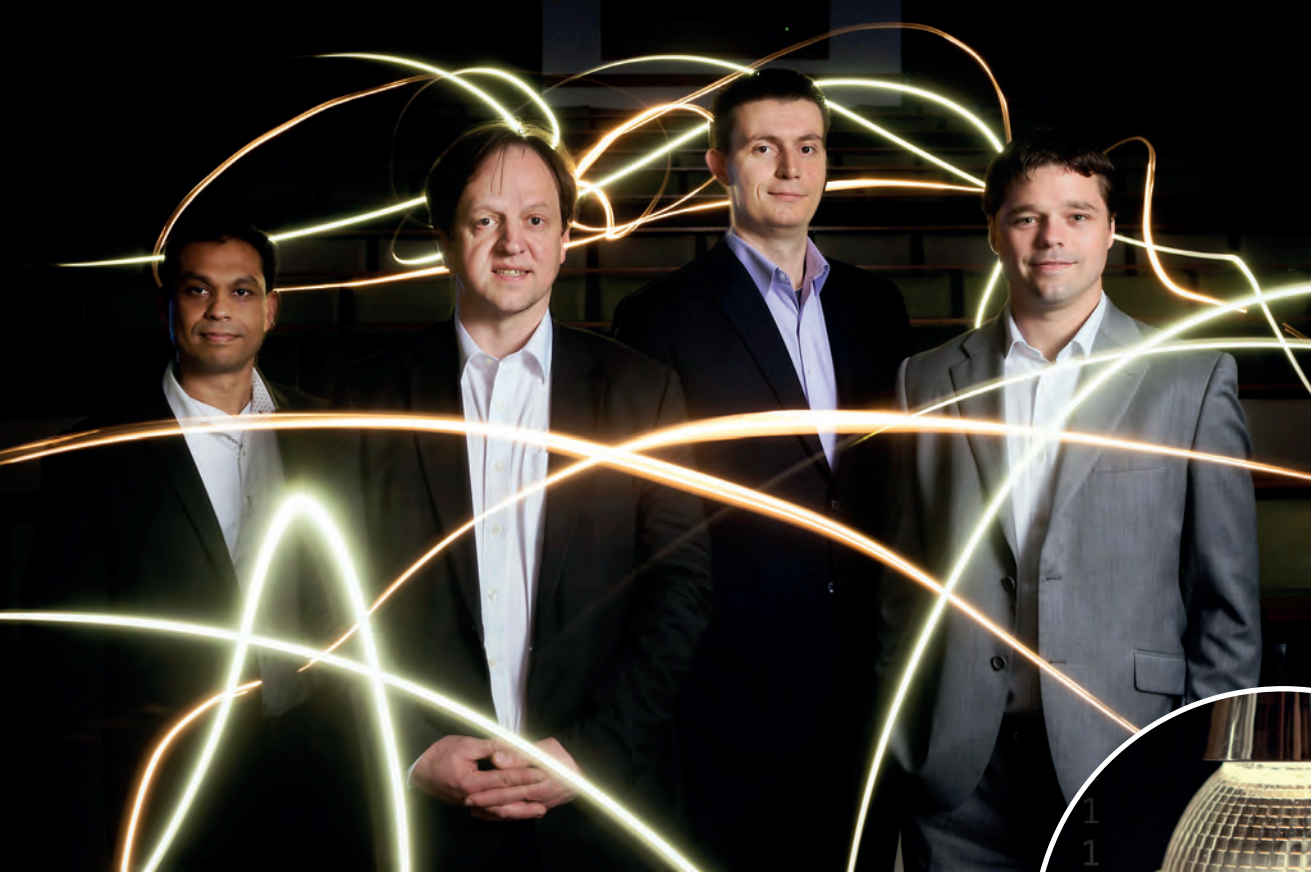
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The ability to safely access the internet at 30,000ft is becoming commonplace nowadays – even a passenger expectation in some markets.

However, as passengers place greater demands on the inflight internet bandwidth, the connected experience could become less of a benefit to the experience and more of a frustration. Fortunately a team in Scotland has devised what they claim is an alternative.

Light fidelity, or Li-Fi, has the potential not only to transform IFE systems, but also to revolutionize cabin and fuselage design, according to its inventor, Harald Haas, professor of mobile communications at the University of Edinburgh.

This state-of-the-art, aviation-friendly wireless technology works by co-opting existing LED light sources to transmit data. As Haas explains, “This technology is perfect for planes as it doesn’t interfere with radio signals in the same way as wi-fi, which uses radio waves. Instead, Li-Fi takes advantage of visible light.

“Li-Fi is a game-changer for three reasons. First, it solves a ‘congestion’ issue. In the data-driven world that we live in, we are running out of radio spectrum. This is a problem in crowded places like airports and aircraft interiors as it means that the current available bandwidth does not support the hundreds of people wishing to use data-intensive applications and the internet in the same place at the same time. Li-Fi solves this issue by using 1,000 times the bandwidth compared with the entire radio frequency spectrum. This is additional free, unregulated bandwidth in the visible light spectrum.

“Second, it paves the way for local-area networks to be established, which means that passengers can make calls,

ABOVE: PROFESSOR HARALD HAAS (SECOND FROM LEFT) AND THE PURELI-FI TEAM, WHO ARE WORKING TO COMMERCIALIZE LIGHT FIDELITY TECHNOLOGY

RIGHT: HARALD HAAS’ VISION COULD ENABLE LIGHTING TO ALSO CARRY ILLUMINATING INFORMATION.
IMAGE: LAURENCE WINRAM

use the internet and access in-flight entertainment systems more easily.

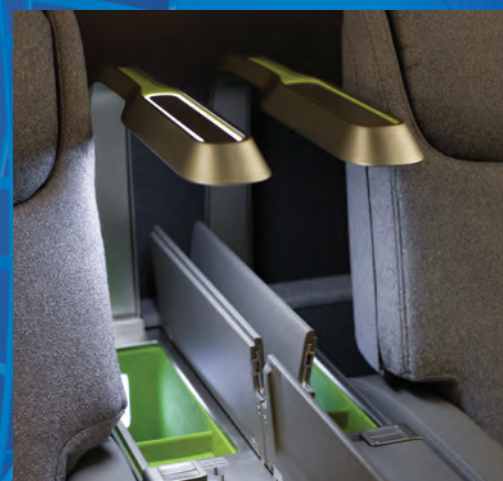
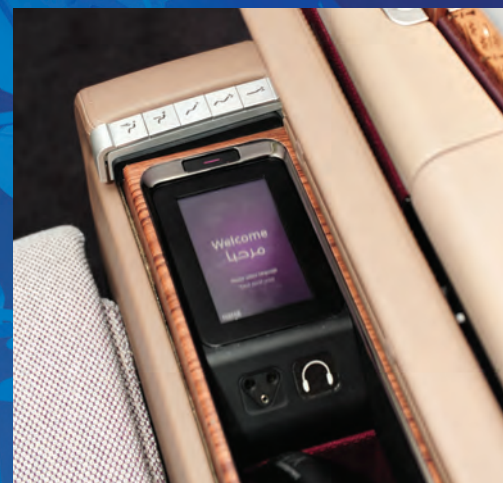
“Third, in a world fast being dominated by big data, safeguarding information is paramount. In the cabin, although Li-Fi signals can leak through windows, the technology offers greater protection to passengers than a wi-fi connection. But the biggest gains will be experienced by OEMs. Their manufacturing halls often have lots of LED lighting and few windows, which will enhance data security in their facilities.”

SO HOW DOES IT WORK?

Haas says, “There are several hundred lights in a typical aircraft cabin. You’ll find them embedded in the seats, the floor and underneath the overhead lockers,” he explains. “But let’s take the passenger reading lights, for example. Let’s not think of them as lights, but as wireless routers. By harnessing the power of Li-Fi, an aircraft cabin can deliver speeds 300 times faster than an average wi-fi connection.”

However, Haas is keen to issue a caveat around performance. “While any LED light source can be used, to guarantee the fastest speeds, aircraft manufacturers would

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HAAS' PURELIFI COMPANY HAS DEVELOPED LIFI-X, THE WORLD'S FIRST TRUE LIFI DONGLE

convert them back into a digital format that we recognize as the digital content, such as a YouTube video.”

WIDER BENEFITS

According to Haas, Li-Fi ensures that passengers don't have to share radio spectrum, as is the case on current flights. Instead, they will have access to a much higher level of bandwidth. However, the potential of Li-Fi extends far beyond enhancing a passenger's in-flight entertainment experience.

“Li-Fi will also prove a liberating innovation for the manufacturer, as it largely eliminates the need for copper cabling in the cabin,” says Haas.

Take the Airbus A380, for example, which is one of the largest passenger aircraft on the planet. Within that giant fuselage there are 300 miles of wiring, which as well as being heavy, also takes up valuable passenger and cargo space. So what will the interiors of tomorrow look like?

“I think that in the future, cabins will be much more modular and malleable. In 10 years' time, almost cable-free aircraft fuselages will allow airlines to temporarily remove entire seating areas and replace them with freight storage zones if passenger demand for a particular flight is low, and vice versa.

“But most excitingly, I believe that Li-Fi will herald the arrival of next-generation cabin designs. If cabling is no longer an issue, aircraft interiors have the potential to become more like the Japanese Shinkansen high-speed trains in their look and feel. Li-Fi opens the way for

“I believe that Li-Fi will herald the arrival of next-generation aircraft cabin designs”

need to install flexible RGB accent lighting, which requires three chips to create artificial white light for the best results. This lighting is more expensive, but it guarantees speeds of five gigabits per second. In contrast, traditional LED lighting only encodes data at a speed of 100 megabits per second.”

For information to be successfully streamed to devices, the technology, which uses the existing LED infrastructure, requires an internet connection and a photo detector. How do these three components combine to generate ultrafast wireless data transmission speeds?

Say Haas, “In the future the avionics databus system on a plane could be used to stream content to each lighting fixture. Each LED light source would transmit the data at high speed to a passenger's laptop, tablet or smartphone. Each device would be fitted with a dongle that contains a photo detector and an LED – typically an infrared LED – to send data back to the lighting fixture. The photo detector would capture and process the intensity changes that each LED light produces and



“In the next three years I can see an opportunity for us to retrofit Li-Fi into aircraft”

manufacturers to install larger windows on planes and bold new seating arrangements, where passengers are at last able to face each other.”

So how many years will we have to wait before this exciting vision of the future becomes reality, and what will it cost?

“With rapid integration and miniaturization of Li-Fi modules, I would predict that in the future the cost to implement Li-Fi into airplane cabins would be between £10 (US\$12) and £15 (US\$18) per unit.

Timeframes in the aeronautics industry are difficult to predict because of the long development cycles and involved qualification procedures for equipment that goes into an aircraft. Also it would help if there were a global Li-Fi

standard. In this context, it has to be said that Li-Fi is currently being standardized in 802.15.7, and pureLiFi is a major player in this process.” Haas is founder and chief science officer of pureLiFi, a developer of visible light communications technology.

“What’s more, innovations in airline cabin design are traditionally quite conservative and the pace of change slow. However, in the next three years I can see an opportunity for us to retrofit the technology into commercial airliners.”

But with Estonian start-up Velmenni having recently tested a Li-Fi network in an Airbus cabin interior in its Bizlab in Hamburg, is the technology nearer to being realized than Haas thinks?

“In an aviation setting and in general, I strongly believe that pureLiFi is the only visible light communication technology provider that currently offers true Li-Fi technology. We are actively driving the 802.15.7r1 Li-Fi standard. This year pureLiFi released the LiFi-X, which is the smallest, fastest and most secure Li-Fi product in the market. We believe that we are the only company in the world that can deliver an untethered, networked Li-Fi internet connection on a plane.”

And with Apple, the biggest technology company in the world, rumored to be showing a keen interest in this next-generation technology, there is no doubt that the Li-Fi revolution is already underway. Whether or not it will bring about a seismic shift in the way commercial aircraft are designed, however, is far from clear. ☒



ABOVE: HAAS EXPERIMENTING WITH LI-FI SYSTEMS IN HIS LAB AT EDINBURGH UNIVERSITY

RIGHT: DATA IS TRANSMITTED BY MODULATING THE INTENSITY OF THE LIGHT, WHICH IS THEN RECEIVED BY A PHOTO-SENSITIVE DETECTOR, AND THE LIGHT SIGNAL IS DEMODULATED INTO ELECTRONIC FORM



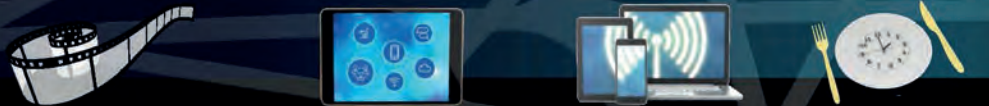
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Creating Textile Values


 Textiles



Engineered excellence

E-Leather believes its eco-friendly engineered composition leather – a combination of leather fiber and a high-performance core – outperforms conventional leathers, faux leathers and fabric materials over a seat's lifetime in terms of appearance, weight, durability and eco credentials.

It is manufactured using leather off-cuts that would otherwise be sent to landfill. The scraps go through a process that physically interlinks the fibers without the use of adhesives. The manufacturing process closed-loop recycles 95% of the process water, converting its own

waste streams into energy that is fed back into the process, resulting in a product that is both environmentally and economically sound.

Over 150 aircraft operators have adopted E-Leather as a result of extended evaluation that included extensive flight trials and independent laboratory testing against competing materials. According to E-Leather, in side-by-side flight tests against conventional leather and synthetic leathers, its product performed best in terms of customer comfort, improved durability and cabin appearance.

LUXURY CLADDING

For a premium appearance on monuments, E-Leather Cladding can offer a luxurious finish that looks and feels just like traditional leather. Being a material, the cladding can be formulated uniquely to meet the correct combination of properties to secure a pass from the authorities for the monument. According to the company, where other types of material have failed to deliver, the precisely engineered man-made E-Leather product can meet the demands of designers and fulfill the requirements of the certification process. The cladding can be ordered in any color and a selection of grains, and is available on a 1.4m roll for ease of use.

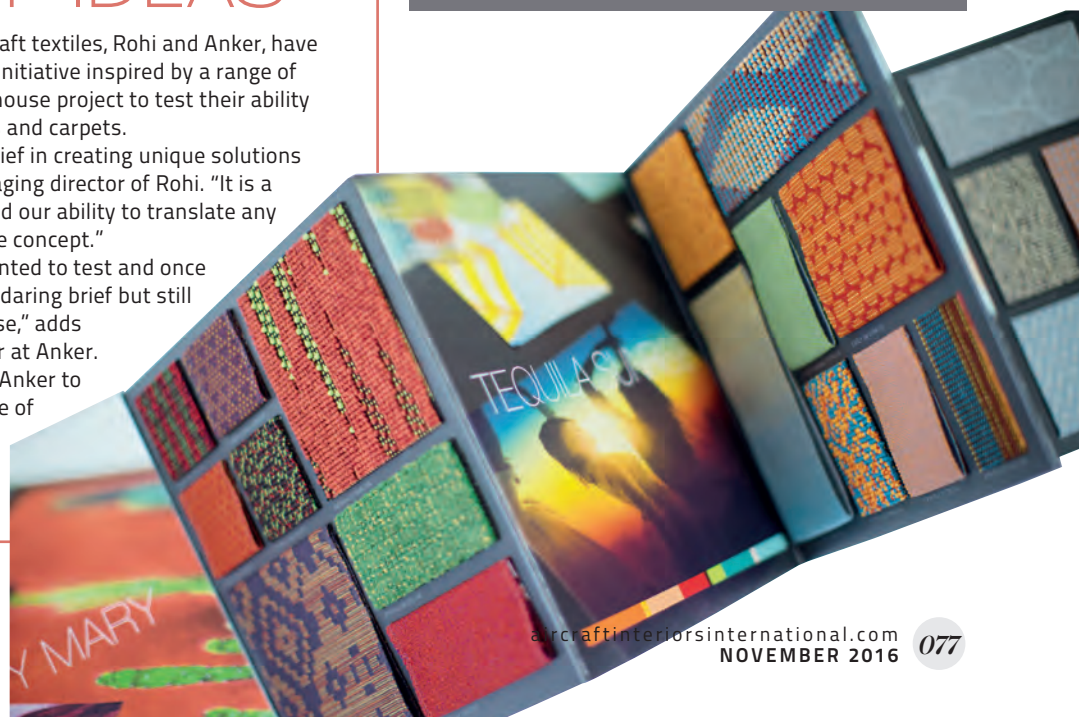
COCKTAIL OF IDEAS

Two leading manufacturers of premium aircraft textiles, Rohi and Anker, have developed the Create Spirit design study, an initiative inspired by a range of their favorite drinks, and the result of an in-house project to test their ability to interpret any idea into a concept of fabrics and carpets.

"This project once again underlines our belief in creating unique solutions for our customers," says Philipp Dahm, managing director of Rohi. "It is a great way to showcase our design talents and our ability to translate any source of inspiration into a meaningful textile concept."

"Our goal is to inspire the industry. We wanted to test and once more demonstrate our ability to work with a daring brief but still deliver a coordinated and considered response," adds Alexander von Fuchs-Nordhoff, sales director at Anker.

"The project set out to challenge Rohi and Anker to think creatively and deliver a smooth package of solutions relevant to our airline customers. Whatever the brief – we can translate it into textiles that make the difference."



Textiles



WOVEN FOR LUXURY

The Tapis Woven Collection combines pure silk, mercerized cotton, and fine linen mixed with performance-driven fibers for exceptional fabrics that deliver the woven beauty, specification and opulence demanded by the luxury aircraft market.

This collection is intended to embody the opulent feeling

associated with the highest caliber of interior design.

With customization and uniqueness in mind, the range of nine elegant textiles comes in nearly 100 colors and sumptuous textures. They coordinate seamlessly with one another and with other Tapis products, yet provide

differentiation from other luxury jet interiors.

In other news at Tapis, its in-house lab has been accepted as a certified FAA testing facility for smoke density, OSU heat release and Bunsen burner testing, enabling quick turnaround for its seat covers and the ability to conduct tests as needed.



Textile effects

To make passengers feel at home, Fuchi Aviation Technology has revealed its latest designs for a textile that combines embossing and blends to create 3D and streamlined effects. This textile brings passengers a feeling of nestling, coziness and security, just like they feel on the couch at home. It adds warmth to the cabin and transforms flying into a refreshing and home-like experience.

Fuchi Aviation can supply lightweight and custom-made textiles and leather, all of which comply with airworthiness regulations. The company can design and manufacture dress covers and interior items, helping give customers one-stop shop convenience.

LUXURY TRAVELLER



This luxurious sofa for aircraft was created in cooperation with the internationally renowned designer Jacques Pierrejean. "Luxury Traveller" offers sophisticated air passengers an extraordinary amount of space, incomparable comfort and

numerous extravagant features. The finest leather and high-quality materials are processed at BOXMARK with diligent skill and guarantee a stylish atmosphere in the first-class sections as well as in business and private jets.



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Flooring



LEATHER FLOORING


A unique environment can be created in an aircraft cabin using F/List leather flooring, developed with Boxmark. The real leather surface is optimized to meet high scratch, abrasion and slip resistance requirements and a stringent qualification program ensures that the flooring meets customer requirements.

However, the real advantage of the flooring is that over time it develops a rich texture that looks beautifully lived in, developing a patina rather than looking worn, enriching the style and charisma of the aircraft cabin. Customization possibilities include square or round tiles, inlay work, marquetry and embossing.



NON-TEXTILE FLOOR COVERINGS

Batiflex AV 155 is Gerflor's latest engineered all-in-one non-textile floor covering. The assembly features a unique multilayer product construction that offers durability advantages while meeting the highest performance and safety requirements. This lightweight product has excellent weldability to reduce corrosion and increased operational efficiency. Batiflex AV 155 is available in a contemporary range of colors and a wide selection of timber patterns, all suitable for installation in galleys, entrance/exit areas and lavatories.

Supple, lightweight carpets

Lantal has introduced two new qualities of carpet – polyamide light and wool/polyamide light – both of which offer lightweight properties. Weighing only 1,150g/m², the polyamide light carpets rank among the lightest products on the market.

Despite their low weight, Lantal says the carpets are dimensionally stable and feature excellent abrasion resistance. The use of popular mouliné yarns extends the spectrum of attractive design options, and thanks to their optimized construction, the two carpet types are easy to cut and lay. Lantal also offers these carpets as accurately pre-cut parts, which results in short installation time and cost savings.

Flooring



Hand-tufted carpet

Before creating its latest collection for NBAA, Scott Group Studio took a step back to really understand the criteria the aviation design community was looking for in carpets. The response? A collection that is conceptual, sophisticated and textural. These designs have a soft, organic and subdued look.

Scott Group Studio has also introduced a 'hybrid' portion of the collection, which combines machine-made goods with hand-crafted details for a swift delivery process. Even though the collection is available in a quick timeframe, it still offers that specialized, opulent touch that can only be achieved through hand-tufting.

3D TEXTURES

An advanced engineered carpet line – Tisca Eco Structure – has been developed for Tisca Tiara's mobility textiles range. This 100% solution-dyed polyamide carpet is designed for ultimate performance, being cost-effective, lightweight, durable, easy to maintain and quick to ship.

Key characteristics of Tisca Eco Structure are a novel 3D texture, a stepped loop-pile design, the highest possible color fastness, lead times of just one or two weeks, and a modest minimum order quantity of 60m².

Moreover, the company has published an inspirational new trend collection of harmonized fabrics and carpets. This collection reflects the latest global trends in terms of designs, textures, materials and color combinations.

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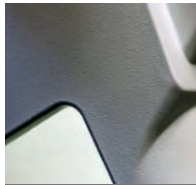
Materials

Boltaron's thermoplastic sheet products not only meet FAR performance requirements, but also act as a design element for aircraft interior components.

The company has developed a range of color, pattern, metallic and translucent sheets that provide opportunities to express creative ideas. New standard and custom textures, such as leather, carbon fiber, felt and suede, bring versatility and dimension to components including seatbacks, tray tables and class dividers.

Further developments using Boltaron's press laminating capabilities offer possibilities to enhance branding throughout.

SHEETS GET CREATIVE



Make an impact

Sekisui Polymer Innovations is the first thermoplastics manufacturer to offer an aviation interiors product line of fully compliant materials, from the flight deck all the way back to economy class.

The company's most recent innovation is Kydex 6565HI, a thermoplastic sheet material specifically engineered for high-impact properties, improving passenger safety when used in seat components requiring head injury criterion (HIC) test approval.

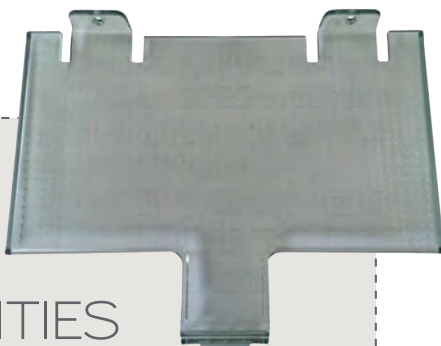
Suggested applications include seat parts, seatback shells, tray tables, monitor shrouds and bulkhead laminates.

Subtle difference

Schneller has launched Opulence, a design collection that demonstrates how a change in texture can move a design from being clean and crisp to soft and warm. Varying levels of metallic and pearl effects can shift the play of light, while subtle variations in color can transform a space. Intelligent alterations in pattern can create vividly different effects.

These aesthetic changes can be achieved through a selection of products, including the new AerTrim softTouch decorative laminate with a luxurious feel, while the AerFilm Flex laminate pushes the boundaries of formability. ✕

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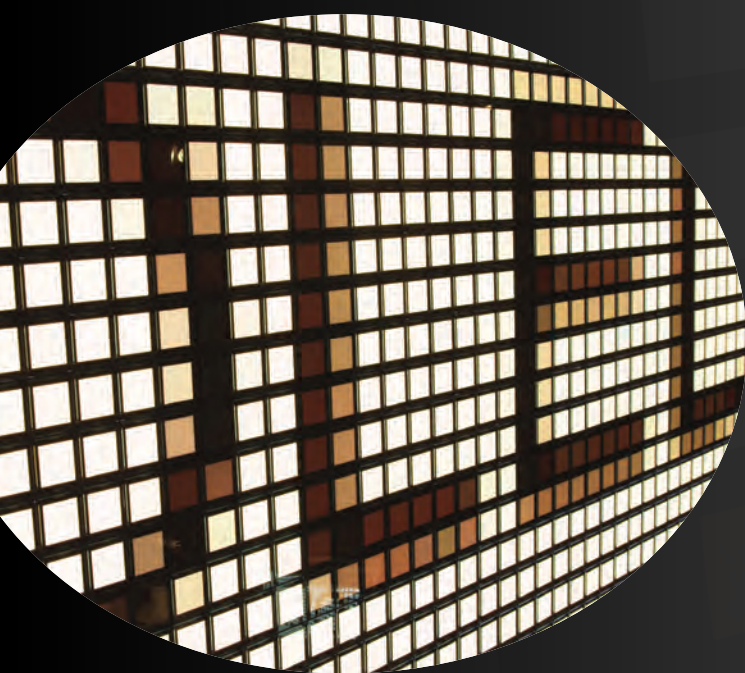
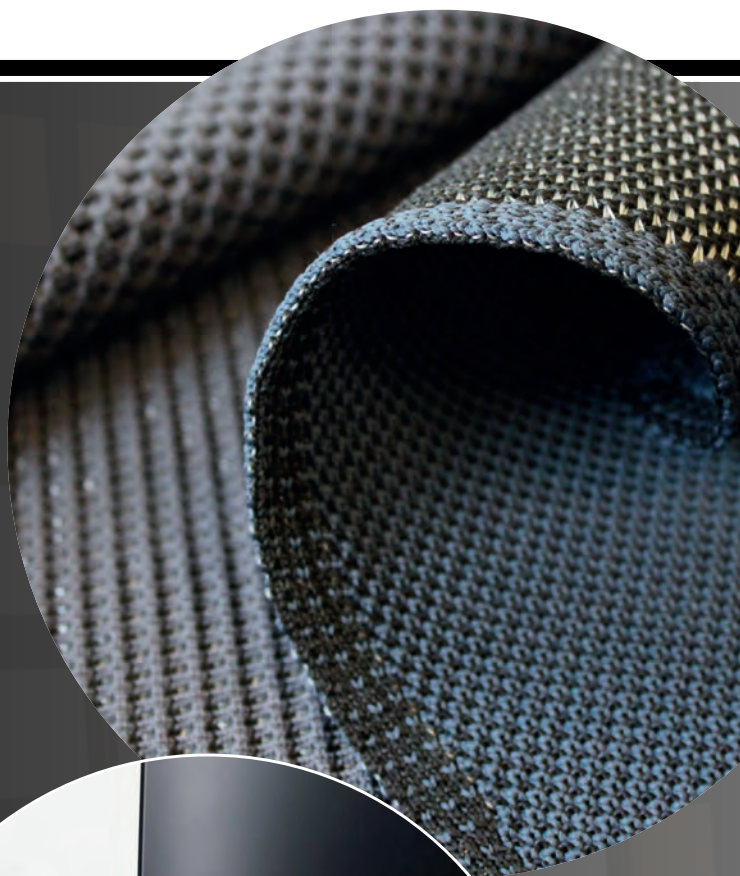
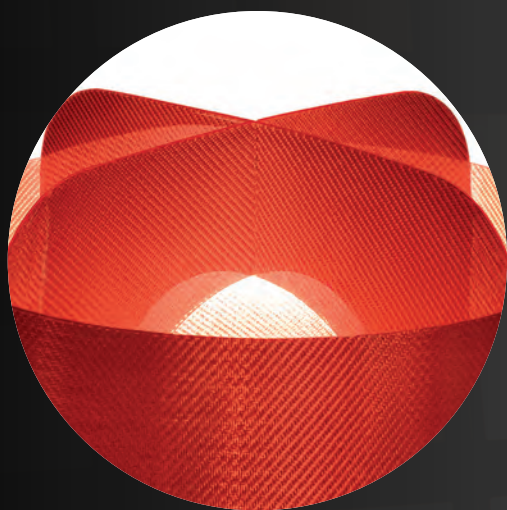
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WHAT MATERIALS WOULD DESIGNERS MOST LIKE TO WORK WITH WHEN CREATING THE NEXT GENERATION OF CABINS? SOME OF THE INDUSTRY'S TOP COLOR, MATERIAL AND FINISH EXPERTS SHARE THEIR WISH LISTS

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CATHERINE BARBER, FOUNDER OF STUDIO CATHERINE BARBER AND CMF CONSULTANT AT ACUMEN DESIGN ASSOCIATES, WOULD LOVE TO WORK WITH OLED TECHNOLOGY – AND REAL WOOD

We are always looking out for new decorative and technical finishes from parallel industries and design disciplines, which we can introduce into the aviation industry. We make a point of sharing our ideas with key suppliers at no charge, to encourage them to explore finishes which we believe will have a strong future in the industry. We are currently lobbying for laminate and plastic manufacturers to look at transforming their materials from passive surfaces to interactive interfaces.

Many suppliers are owned by parent groups with several businesses serving the transport and architecture sectors, but surprisingly few seem to share ideas, technologies and R&D, or to sponsor joint programs. It is something Acumen is trying to facilitate, as it seems an especially efficient way to channel knowledge and

bring innovation to a market which is hungry for progress.

If we have to champion just one material it needs to be one that delivers maximum benefits. We would like to see OLED lighting and screen technology on board. OLEDs are brighter yet consume less power than LEDs. They can be manufactured in large thin plastic sheet format, and so have very versatile applications. A large field of view, about 170°, means that images can be viewed clearly at an angle.

At present OLEDs have a 14,000 hour life (LEDs have between 46,000-230,000 hours). This, combined with their cost, means they will remain on our wish list while manufacturing and technology are perfected. So while we wait for this, can we also have real wood veneers which pass the flammability tests? Or is that greedy?

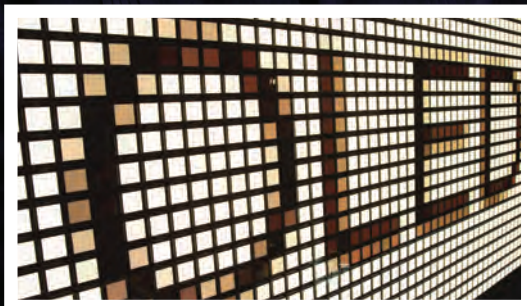


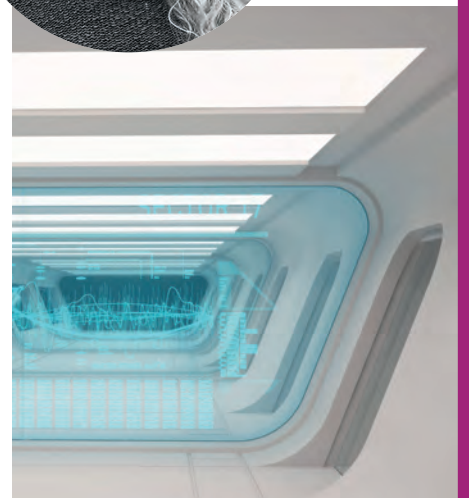
Image: Philips

REAL WOOD AND GLASS, AND EVEN RUBBER, ARE THE WAY FORWARD FOR RACHAEL GARTSIDE, FACTORYDESIGN'S RESIDENT TRIM & FINISH SPECIALIST

We have specified real wood on projects, but it has been constrained to areas stowed during TTOL. It would be great to be able to specify real wood, of any variety, in cabins, as it has a lovely tactile quality which we try to bring to the interiors we work on, adding a natural warmth to what can be quite a sterile environment. Being a natural material, each piece is unique, which would be a strength, particularly on premium seats, where a bespoke experience is desired.

The effects that glass can produce are extensive, from blown glass light shades to LED illuminated panels with glowing edges and etched patterns. The intriguing way light plays with glass gives it many interesting possibilities in the cabin environment, particularly if attempting to balance the effect of an open cabin with private seats. We have worked on projects trying to achieve these effects with the alternatives available, but being different compositions they don't always have the necessary properties.

Used as a coating, soft touch rubber would be an interesting material to use for detailing around seats. The finish is now seen regularly in product design and the automotive industry. The matte finish looks particularly good when juxtaposed against a high sheen surface, creating both a tactile and visually interesting look.



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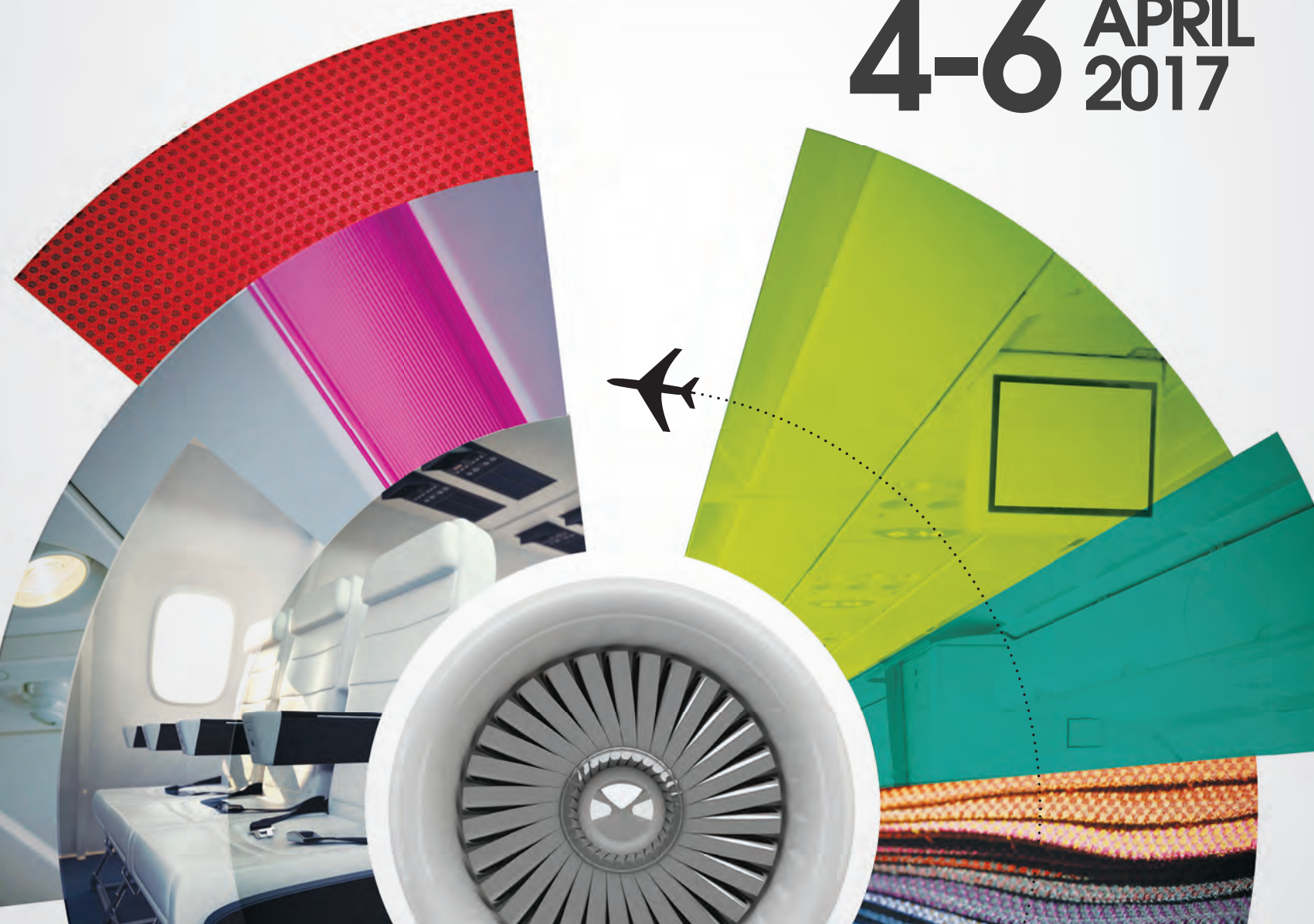
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IT'S TIME FOR CARBON FIBER TO SHINE, SAYS ANGELINE MOURA, JPA DESIGN'S CMF GROUP LEAD

Synonymous with performance but not valued for its inherent aesthetic, carbon fiber is familiar to the aviation industry, but has now reached a new age, and promises a rainbow of new possibilities.

The advent of new process technologies ushers in a fresh and, crucially, softer perception of the material. Carbon fiber can now offer scale without costing a weight penalty, and a surface that appears alive.

Decode's carbon lamp, made of thin sheets of interlocked Hypetex, not only creates a structural geometric form, it also permits illumination through its colored weave.

Similarly, Kartell launched an ultra light and thin chair at Milan Design Week, which showcased a fiber-reinforced polymer providing mechanical rigidity and low weight.

With its aesthetic and technical evolution, a new palette and design language for carbon fiber are waiting to be explored further.

CMF & TEXTILE SPECIALIST EMMA RICKARDS OF WEST 6 WOULD LIKE TO INTRODUCE A LITTLE GLAMOUR FROM THE WORLD OF HANDBAG DESIGN INTO THE CABIN

An unintended consequence of the digital era is a new yearning for emotional and tactile solutions. Good cabin design becomes less about needs and more about emotional impulses. I'd love to blur the line between designer handbags and the airline industry, and to accessorize the cabin with shots of color and truly amazing bespoke leather finishes. It might be a deep embossed croc that's cut to create a scale-like texture, perhaps a Louisiana alligator, or a trim of Ayers snakeskin printed with python markings.

Or it might be the smooth metallic gleam of an evening bag, translated into a dazzling curtain using a high-performance flame-resistant fiber, that will accessorize the cabin with a pop of color.





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MARIA KAFEL-BENTKOWSKA, SENIOR CMF DESIGNER AT PRIESTMANGOODE, HAS BEEN DREAMING OF EVERYTHING FROM TRANSLUCENTS, TO KNITS, TO VELVET

One material we've been wanting to use is decorative transparent and translucent plastics, and by working closely with suppliers, we've finally been able to make this happen in the United Polaris cabin. Such plastics offer interesting opportunities for adding color, pattern and layering throughout the cabin, without adding bulk. There is, however, still a long way to go in developing some of the effects that are already commonplace in the hospitality industry, such as beautiful smoked, opalescent or etched finishes.

We're also closely watching the development of stretch, knitted and spacer fabrics, which are currently undergoing certification tests. The durability still needs to be tested and managed over time, but this could offer a new concept in lightweight, comfortable travel.

At the premium end of the aircraft, the silky soft, sumptuous texture of velvet would add a luxurious feel to first class interiors. While these fabrics occasionally make it onto our inspiration boards, we're still some way off being able to use them on commercial aircraft.



IT'S NOT WHAT YOU USE, IT'S THE WAY THAT YOU USE IT, ACCORDING TO ELINA KOPOLA, FOUNDER OF TRENDWORKS

I believe it's not the individual material that creates the mood, but the combination that captures our imagination. I can imagine how we could transform travel from a 'one size fits all' approach into a truly individual experience full of surprise and delight. Let's apply authentic, tactile elements, our favorite material qualities from the home environment.

Let's show craftsmanship in real wood, unique stone, high-performance porcelain, mesh lighting and woven natural fibers of wool, cashmere and crisp linen. Then let's add a new frame of reference, by integrating innovative digital solutions to create interactive walls and furniture that come alive, to inform and soothe us with immersive entertainment and ephemeral imagery.



3D KNITTING WILL OPEN UP NEW POSSIBILITIES IN CABIN DESIGN, PREDICTS CAMILLA SUNDWALL, SEYMOURPOWELL'S CMF SPECIALIST & TREND RESEARCHER



In our design work we are seeing a growing need for environments that are adaptable to each person's individual needs, and we are also seeing how diverse these needs can be. It is very exciting to witness recent advances in material sciences and textile production, many of which fit these challenges

perfectly. Using 3D-knitted structures opens up new possibilities in terms of seat comfort, while making it possible to rethink the basic construction of back shells and privacy screens. We'd like to see this combining with shape-changing polymers integrated into the fabric to create living textiles that could morph or transform.

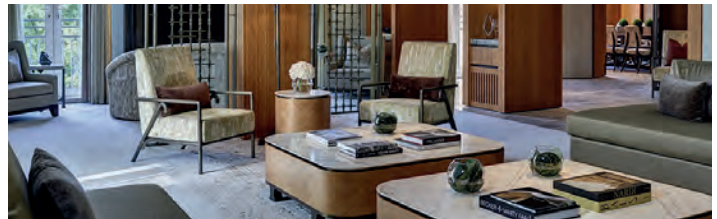
Images: Seymourpowell



FOR MONICA SOGN, SENIOR CMF DESIGNER AT TANGERINE, IT'S TIME TO INTRODUCE REAL LUXURY INTO THE CABIN – NOT JUST AVIATION LUXURY

There is an industry-wide desire to introduce greater luxury into the premium aviation market, which can be a challenge, given the current offer of materials. We would love to be able to use thicker and more luxurious fabrics and carpets in the cabin, to soften the space. The introduction of real natural materials like wood and stone would also offer deeper, richer textures.

For vertical surfaces, paper-like wallpaper textures, linens and silks would take a largely synthetic-feeling space closer to the atmosphere of a luxury hotel. The big challenge here will be the additional weight on board and adherence to the strict fire, smoke and toxicity regulations. We'd also be interested to see the development of responsive fabrics and plastics, which could help to create a more seamless, connected and comfortable passenger experience.



LET'S ADOPT A SOFTLY SOFTLY APPROACH, SAYS DANIELA SAUCEDO, CMF EXPERT AT MORMEDI

Materials selection in the airline industry is moving toward more flexible solutions, but it still faces real challenges. Customers are demanding warmer and cosier environments while also being more conscious about environmental issues and sustainability.

A real solution is not about adding a 'magical' material, but about enhancing the whole set of elements in the cabin. In terms of textiles, the commercial industry still needs softer materials that can resist high traffic. Durable soft-touch finishes

and flexible plastics can also help to improve the seat ergonomics and humanize the space.

Finally, we believe that magic glass, which is used extensively in the hospitality and retail industries, can be ideal for customizing passengers' privacy. Looking further into the future, we are paying close attention to aero graphite on account of its lightness and numerous potential applications in the aircraft industry. ☒



Image: Sese Ingolstadt

Aircraft interiors

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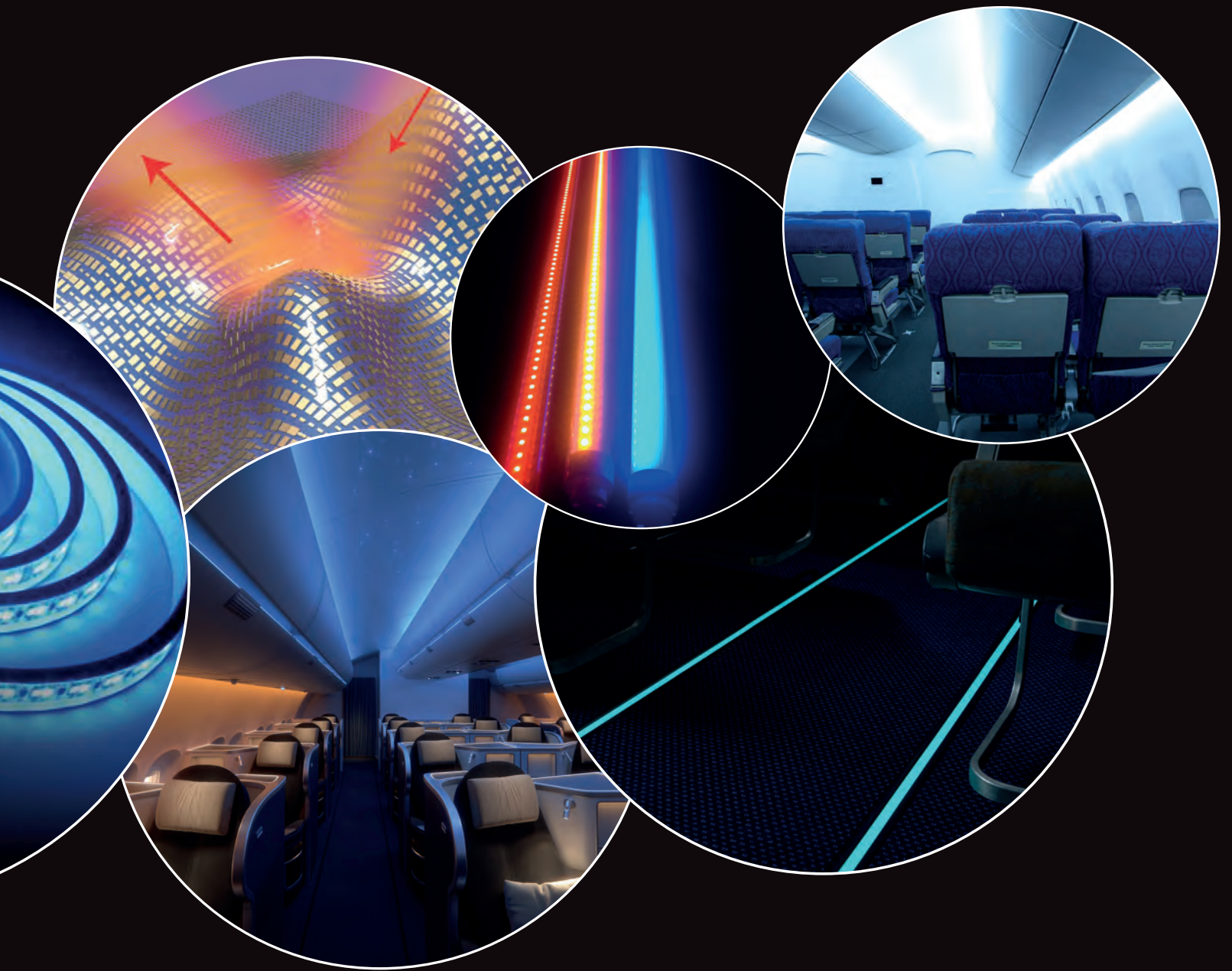


VISIBLE

For too long, cabin lighting effects were considered an afterthought or the preserve of premium cabins. Happily those days are behind us and cabin lighting is now a fast-moving and innovative sector. Catch up on the latest developments, and what the future could hold...



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FLEXIBLE APPROACH

According to B/E Aerospace, next-generation technology and future advances in LED lighting will be driven by improvements in LEDs and a new class of lighting products. The company's engineers have been working to solve the problems of LED inefficiencies, heat-sink requirements and color inconsistencies and have developed the Viu lighting system, which replaces large, rigid light bars with a flexible design to open up new design possibilities and ease installation. The technology earned a 2016 Crystal Cabin Award.

Now B/E is working on a smaller Viu product family that measures only 0.25in (6.35mm) wide and is addressable down to the LED 'pixel' level. This bright flex source can be used for animations, precise zone breaks and localized lighting that has the potential to replace reading lights, escape path and general cabin light bars, essentially unifying the cabin lighting experience and enabling airlines to differentiate themselves by adding unique possibilities for brand expression.

The global commercial aircraft lighting market will grow at a CAGR of 5.1% over the next 10 years to reach US\$2.54bn by 2025
Research and Markets

LEDs take an active role in branding

Imagine the design possibilities if active LED lighting effects could be integrated into seat textiles and curtains – or even crew uniforms.

An 'e-broidery' technology has been developed by Forster Rohner Textile Innovations that enables the integration of active lighting into fabrics without compromising textile properties such as washability and drapability. The textile interconnection, LED fabrication, and integration procedures have been custom developed into an industrial production process that could enable the technology for wider application.

So far it has been applied in subtle forms in home bed linen, room dividers and fashion, and even to create animated t-shirt designs, but if such technology could be approved for use in the cabin, exciting new design and branding opportunities would open up.

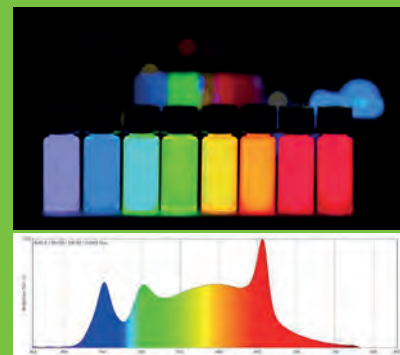
HYPERGAMUT TECHNOLOGY

The R&D team at B/E Aerospace is constantly monitoring and exploring new lighting technologies such as quantum dots, organic LEDs, electroluminescence, advanced optics and encapsulation materials.

As part of its research, B/E Aerospace has found that by using several smaller, low-power LED sources instead of a fewer large ones, more colors can be mixed in cabin lighting, creating a larger color gamut, higher color rendering index (CRI) and metamerism. This

approach also enables lighting designers to create specific colors in two or more ways to produce unique cabin effects.

With this in mind, the company's next-generation lighting system, Hypergamut, will employ multiple primary colors. The future lighting system is predicted to achieve a CRI of 100, with a color gamut exceeding the newest 4K HD TV standards and the ability to dim down to 0.01% while maintaining color accuracy.





EYE CANDY CREATES SALES

Ancillary revenue is big business – US\$26bn a year for today's top-10 earning airlines – showing the importance of creating customer appeal for onboard shopping. Lighting technology could create opportunities to generate extra sales through more commanding and memorable retail experiences.

Lighting giant Philips has been working on an embedded lighting system that fuses LED lighting into architectural surfaces and retail displays, providing layers of visual richness to attract foot traffic, create brand impressions and drive sales. The embedded lighting mixes patterns of light and uses integrated shelf lighting and digital media systems to “steer the discovery, guidance and exploration of the merchandise”.

A background layer acts as a canvas to draw attention and pull guests to the merchandise. Every point of light is digitally controlled, with mesmerizing dynamic animations bringing the surfaces to life. If there is space available, the background layer can incorporate luminous animations that span an entire wall to attract attention from a distance. As the potential customer moves closer to the retail display, the background layer recedes from focus.

Light is placed close to the merchandise, to draw the focus to the goods. Ultra-thin LED strip lighting is integrated into thin shelves, with the bright surfaces making the merchandise appear much brighter than the larger background, enticing customers to reach out and touch the goods.

To help guide shoppers to the products they seek, a middle layer between the long view and the close view creates an opportunity to hook and guide customers using digital content incorporated into a digital screen, a projected augmented reality overlay, or even an interactive experience that senses a person's presence, location or touch-to-trigger content scenarios. With all three layers – background, foreground and digital overlay – digitally controlled, the entire display can be scripted to engage shoppers from far to near.

A moving experience

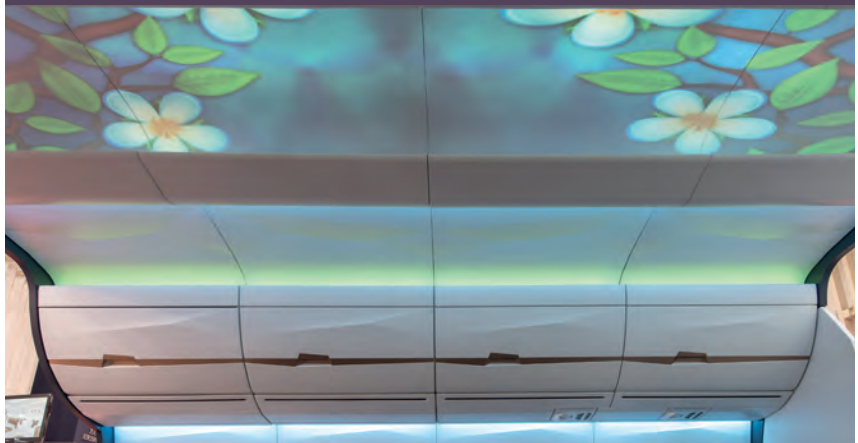
Diehl Aerospace is currently working on what it calls the Projection Enabled Flight Experience, developed with an eye to the technical aspects of future lighting products, as well as the expectations of passengers, airlines and aircraft manufacturers. This fully integrated system combines lining elements and surfaces with image projection and cabin lighting to create a new kind of flight experience.

The team is working to include versatile elements into cabin design, such as graphical designs, pictures and moving images that can be adapted according to airline requirements. The embedded projection system is the technical enabler for creating atmosphere in the cabin, but also allows value-add applications such as color

branding, displaying information for passengers, or advertisements.

“In the early 2000s Diehl introduced the first mood-lighting systems in premium cabins. We believe that the next step will be static and moving images in combination with mood-lighting installations, such as our Projection Enabled Flight Experience,” states Marc Renz, head of cabin interior customization at Diehl.

“There are still some technological challenges in front of us. Commercially available projectors are not made for curved ceiling projections or for use in an aircraft. In addition to the physical installation, a few of the problems we are about to solve include integration into the cabin management, and data and content handling.”



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Holistic view

For a long time, the aircraft cabin lighting industry has failed to meet the supposedly simple requirement of arranging various lights to create a coordinated overall lighting effect. Now that requirement has finally been met, Schott Aviation believes that its latest technology – claimed to be “the first holistic cabin lighting system” – offers new opportunities in cabin design.

“When looking at perfect light settings – as found in nature, for example – one finds that a mix of color tones and intensities creates truly stunning moments,” says Klaus Portmanns, sales director at Schott Aviation.

“We took this inspiration and transferred it into a cabin lighting context. The result is a truly advanced cabin lighting system that integrates our HeliLine ambient contour light solution into the overall lighting concept.”

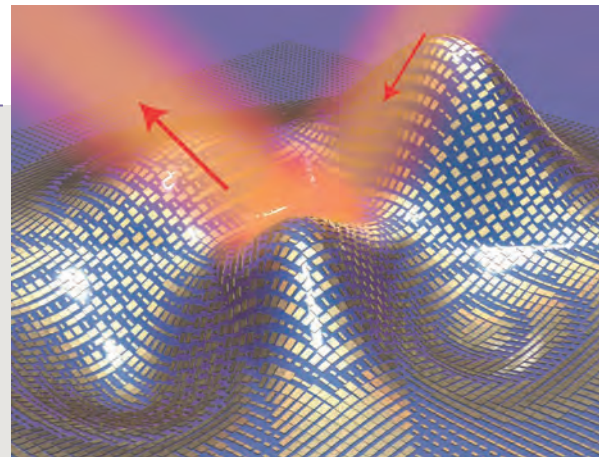
NOW YOU SEE IT...

Imagine being able to make unattractive parts of a cabin disappear from sight. Scientists at the US Department of Energy’s Lawrence Berkeley National Laboratory (Berkeley Lab) and the University of California, Berkeley have devised an ultra-thin invisibility cloak that can conform to the shape of an object and conceal it from detection with visible light. Although this cloak is only microscopic in size, the team believes that the principles behind the technology should enable it to be scaled-up to conceal macroscopic items as well.

Working with brick-like blocks of gold nanoantennas, the Berkeley researchers fashioned a cloak barely 80 nanometers in thickness, that was wrapped around a three-dimensional object about the size of a few biological cells and arbitrarily shaped

with multiple bumps and dents. The surface of the cloak was meta-engineered to reroute reflected light waves so that the object was rendered invisible to optical detection when the cloak was activated.

“This is the first time a 3D object of arbitrary shape has been cloaked from visible light,” explains Xiang Zhang, director of Berkeley Lab’s Materials Sciences Division and an authority on metamaterials – artificial nanostructures engineered with electromagnetic properties not found in nature. “Our ultra-thin cloak now looks like a coat. It is easy to design and implement, and is potentially scalable for hiding macroscopic objects.”





Lighting can enhance long-haul well-being

Long-distance air travel can be stressful, so Airbus, Diehl Aerospace, the Bergische University of Wuppertal, the Fraunhofer Institute and Osram have conducted a study to verify the possibility of controlling the moods and emotions of passengers using biologically effective light.

The study partners hypothesized that the use of adaptive and active LED lighting could make long-haul passengers more relaxed during flight, helping them land feeling more active than passengers flying in aircraft with standard lighting.

The effects of five core phases were analyzed in simulated flights: the waking and falling asleep phase, in an 'evening red' color; the 'night' sleeping phase; the waking up phase in 'morning red'; the awake phase in 'morning blue'; and the landing phase.

The week-long analysis included reports from test subjects, saliva analyses, video recordings and body motion analysis. Two test groups, each with 16 people, carried out three simulated flights. The groups were subjected to sleep deprivation and relaxation phases,

all scientifically controlled according to flight sequences.

It was found that light with a high red component is more calming than standard lighting, with higher levels of the sleep hormone melatonin being recorded, and subjects being calmer and moving around less.

The study concluded that with chronobiologically adapted LED lighting, long-haul passengers are more relaxed and reach their destinations more refreshed than passengers in cabins equipped with conventional lighting.

Into the blue

EASA has approved STG Aerospace's latest photoluminescent floorpath marking system, saFTglo blu, for the A300, A310, A320, A330 and A340.

This is the first time an emergency egress system using blue photoluminescence has been approved for use in any aircraft application, and the technology provides a unique color glow for operators and cabin designers preparing to modify or upgrade Airbus aircraft interiors.

Engineered from the company's existing saFTglo photoluminescent range, saFTglo blu emits a blue glow, a noticeable change from the traditional green that has always been associated with the product, and enables

airlines to subtly transform cabin aesthetics without compromising passenger safety, by means of simple illumination. The floorpath marking system can also blend seamlessly with mood lighting systems.

In daylight, the body color is whiter than the glow produced by conventional photoluminescent systems, meaning that when it is used with any translucent film or overlay, the result is a truer, brighter, cleaner color. In darkness, the glow has a calmer, softer, more reassuring quality while still performing the critical safety function the system provides.

The origins of the design are based in science, specifically the results of a human

perception analysis that showed that the blue wavelengths of emitted light enable enhanced passenger perception of the emergency track with a human eye adapted to the dark.

The EASA approval process for saFTglo blu was executed using STG Aerospace's own in-house design organization approval (DOA) procedures and, using its in-service performance data, the company has been able to reduce the maintenance burden for airlines by minimizing the requirement for inspections. As with other versions of saFTglo, saFTglo blu is easy to install – typically by an airline's own technical staff during an overnight shift.



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Light entertainment

In addition to a wide range of cabin lighting effects, LEDs could be used as a medium to deliver high-speed communication, such as streamed IFE content. The radio waves used by wi-fi systems in the cabin environment can become congested, but li-fi (light fidelity) can open up new possibilities by using visible light waves as a bidirectional, high-speed and fully networked wireless communication technology, without causing electromagnetic interference.

For full details, see p66



COMPACT READING LIGHTS

Beadlight has developed a range of new aerospace reading lights – named Stellar, Mono and Sirocco M – designed to respond to market demand for thinner lighting fixtures. A reduction in depth means the lights can be fitted within a panel, thus offering reduced panel depths.

The Stellar is a touch-sensitive light designed to complement any seat design, and with a depth of 20.5mm, it is versatile enough to fit in small spaces and panels. The Sirocco M is the company's smallest light fitting, and its 35mm diameter front face can be adjusted $\pm 25\%$ right to left.

The Mono model has a pop-open mechanism that fits into a reduced depth case. This light, despite its size, is offered as a 12-28V variable solution.

FAST AND EFFECTIVE

For airlines looking to retrofit LED lighting across their fleet in a short time, Madelec Aero's Bi Colour LED lighting system enables a cabin lighting installation to be completed within six hours. Delta installed the system on 118 aircraft within eight months.

To complement the LED tube cabin lighting, the company has also developed a galley/entryway and LED flat-panel drop-in solution, which is available in either single or bi-color options. A bi-color lavatory lighting system is also available.

The company's strategy is straightforward: to ensure that the design is simple and cost effective, and to keep the number of parts and variants low. For example the PSU driver combines the OEU and CIDS interface so that the same driver (ballast) can be supplied for Airbus and Boeing options. By keeping the system modular,

manufacturing and raw material costs can be kept to a minimum.

The bi-color system – tri-color is also available – is claimed to be more reliable than RGBA systems, as well as being less expensive to buy and to install.

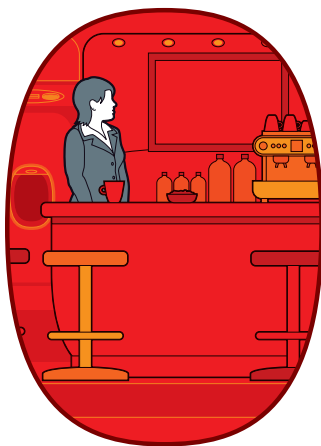
"I have flown on many aircraft, from the A380 to the latest A320Neo, and the RGB system has flaws," states Geoff Livingstone, president of Madelec Aero. "The color matching is usually out and several tubes will have failed. The obvious question is how many airlines need 50,000 color options. Most use two or three colors. Many customers are coming to us to replace their failing systems with a less complex, more reliable solution."

The systems can be fitted as an OEM line fit, but Madelec has found that the main demand is for the retrofit market, with many customers wanting the equipment supplied with an STC. ●



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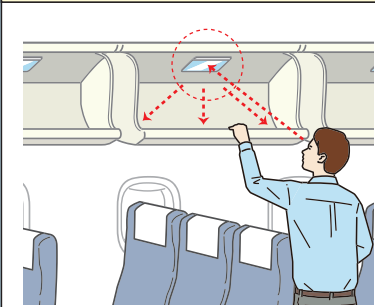
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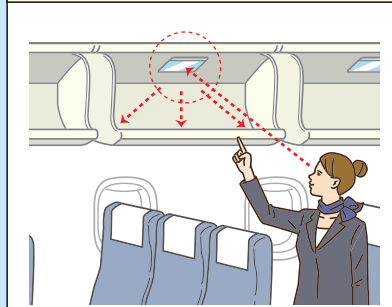
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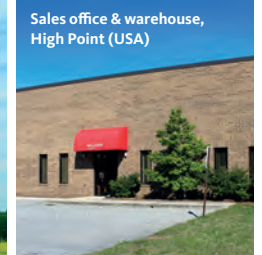
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SEEING AND BELIEVING

STG Aerospace explains why it's all about the quality of light

It might seem simple: either the lights are on or they are off. Either you can see things or you can't. But according to STG Aerospace, a company with a rapidly growing reputation for innovation in aircraft cabin lighting, there's a lot more to it than that. Research shows that the quality of the light around us has a profound impact on how we feel and how we behave. Light isn't just important for visual performance, it's important for biological performance, for health and wellbeing too.

In an enclosed environment such as an aircraft cabin, however, it is not always easy to get the lighting right. Even during daylight flying, natural light is having to work with, or against, the cabin's ceiling lights, sidewall lights, reading lights, galley lights, photoluminescent floor path lights and more. So it requires a holistic approach, which, as STG Aerospace is continuing to show, can deliver a number of benefits.

According to one recent study conducted by Boeing, with the right lighting passengers perceive the aircraft to be newer, cleaner, more comfortable and even to have better air quality – even though nothing apart from the lighting has changed. Airlines can also choose to match the color of their lighting to enhance their brand identity, either directly or by using a quality of lighting that makes colors, including an airline's brand colors, appear more 'true'.

Research continues and STG Aerospace is currently working with universities to ensure that its photoluminescent and LED lighting systems are optimized for every phase of any flight. In particular, the company is focused on how lighting can be used to enhance the passenger experience, including reducing stress levels for

STG has also developed a new emergency floorpath lighting system – see p104



nervous flyers. Relaxed and comfortable passengers are more likely to be return customers; they may even be more inclined to make the in-flight purchases that form an important part of the business model for low-cost carriers.

The new reading light from STG Aerospace is one very good example of how lighting can be tailored to a specific application within an integrated approach. Studies have shown that reading is the primary passenger activity on short-haul flights, which is why the company has designed a specific light – part of its LED liTeMood product range –

that not only improves the perception of books, magazines and electronic devices, but also, with its square light pattern, maximizes control of personal space and minimizes light spill onto neighbors.

For very sound safety reasons, the aerospace industry has typically been a late adopter of new technologies, as they need to be thoroughly proved before they can be installed on an aircraft. However, although the product development process is a continuous one for STG Aerospace – it has a highly advanced R&D facility in Cwmbran, Wales – the company has an extensive portfolio of cabin lighting concepts that are tried, tested and approved for manufacturers and airlines to take full advantage of the benefits they can deliver.

Get the quality of the lighting right and everything else follows. ✕

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ONE STEP AHEAD

Recaro is ushering in a new era with its intelligent aircraft seats

Every third seat for single-aisle aircraft is manufactured by Recaro

Check in to Recaro's business class. The company's innovative CL6710 seat offers a full-flat bed, as well as a wide variety of options for customization to airline-specific needs, ranging from numerous privacy and stowage solutions, to the look and feel of the seat control unit, and various trim and finish options – all designed to combine comfort with cabin density.

On its way to becoming the company's Internet of Things flagship model, this seat will be given new features in the near future. For Recaro, 2016 has been all about intelligent seats and tailor-made applications for customers.

"As a premium brand, we see ourselves as trendsetters and thought leaders. These innovations will generate greater value for our customers and their passengers – one that ensures easier operation and enhanced compatibility," says Dr Mark Hiller, CEO and shareholder of Recaro Aircraft Seating. "And of course, a new technological advancement also has to deliver significant financial benefit to Recaro customers – in this case, savings in terms of time and money."



With this in mind, the CL6710 is being adapted to automatically deliver information on its operational status. At any time, the cabin crew and engineers on the ground can monitor whether a seat is fully functional and ready for use. The technology and hardware for this premium seat form the basis for this solution in the context of the Internet of Things.

Recaro is developing user-friendly software solutions for airlines, which can communicate information pertaining to the seat's functionality and condition. The objective is to capture valuable load data and statistics on seat use in the cabin, and then to communicate this to the ground station. The market and business outlook for this highly sophisticated project are positive.

SIGNS OF GROWTH

Performance figures and full order books for the current year bear witness to the rapid growth of the company from Schwäbisch Hall in southwest Germany. With sales of €409m (US\$462m) in 2015 – a record high for the company – Recaro is expanding its leading position in the international market.

"With a reinvestment rate of over 10% of sales into research and development, we are ahead of other seat manufacturers. This shows just how important innovation and satisfying customer needs are for us," adds Hiller.

The next year will also see Recaro heavily involved with a key area of innovation that transcends previous definitions of seat functionality: the Intelligent Seat, which was introduced at Aircraft Interiors Expo 2016. ✕

double award

In 2015, the CL6710 was honored with the German Design Award and the CL3710 long-haul economy class seat won the prestigious design award in 2016. Two different seats – one design.

Recaro calls it 'Ingenious Design' – the successful combination of ergonomics, functionality and aesthetics targeted at offering customers the best possible seat. Exclusive materials such as leather and fabric seat covers, clear lines and contours emphasize the visual comfort and the premium quality of these 'made by Recaro' products.

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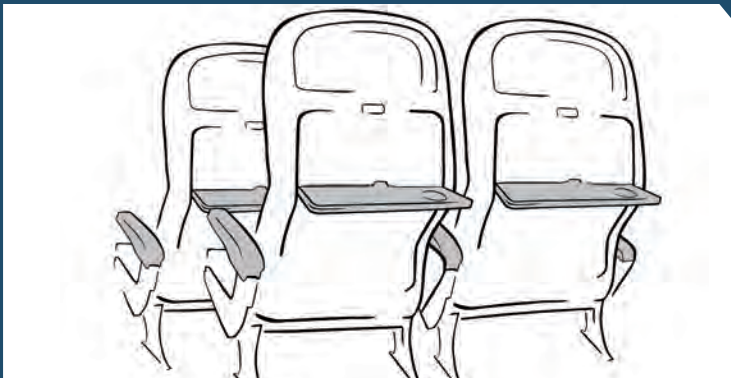


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MOVING TARGET

Schneller's engineering team has developed an innovative repositionable flooring product

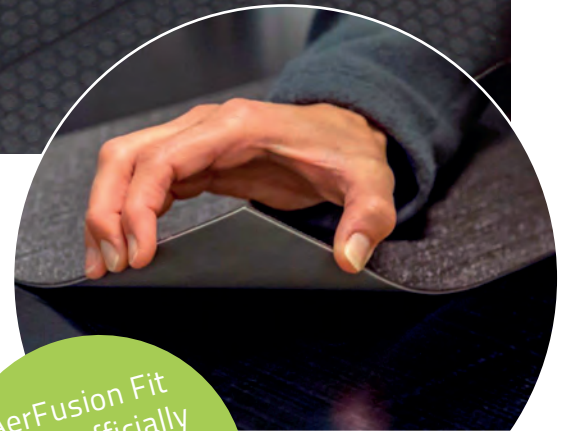
More than half a century ago, Schneller entered the airline interiors business by outfitting the legendary Douglas DC3 aircraft. By combining R&D-driven innovation and pleasing aesthetics, the company grew to become one of the largest in the aircraft interiors industry.

Schneller's enduring goal is to combine a high level of technical sophistication with design leadership. This is why the company was so pleased to receive an inquiry about a possible new non-textile flooring innovation for one of its airline clients.

"A major airline came to us and said they would like to put a new product in the Boeing 787," recalls Brian Rowles, product development manager for Schneller's specialty products division.

Over the next year and a half, Schneller's product engineers and designers went to work on the new flooring material, which is now called AerFusion Fit. The material – which will be launched formally next April at the Aircraft Interiors Expo in Hamburg, Germany – can be applied in entrances, aisle ways, galleys and lavatories.

In anticipation of the roll-out, as engineers performed fire tests and other late-stage checks, word began circulating about the product. "Airlines all over the



AerFusion Fit will be officially launched at Aircraft Interiors Expo in April 2017



world have asked about it," says Jim Flanders, a senior process engineer at Schneller. "With possible retrofits in mind, Schneller also expects to make it available for refurbishments through aftermarket channels."

The new flooring product contains an integral repositionable adhesive system that allows precise correction where needed. That means it can be cleanly removed from cabin floors at the time of installation, or long after it is originally installed. AerFusion Fit is easy to clean and maintain. Along with the properties already mentioned, it also offers superior buckling and telegraphing resistance, and world-class dimensional stability. ✕

ABOVE: THE REPOSITIONABLE ADHESIVE SYSTEM MAKES AERFUSION FIT A VERY CONVENIENT FLOORING PRODUCT

LEFT: AERFUSION FIT IS AVAILABLE IN A VARIETY OF COLORS AND FINISHES

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To request more details from Schneller visit www.ukipme.com/info/aim

LEAN AND KEEN

High quality and employee motivation can be achieved for cabin products by working with Toyota's management methods

Ebco is an experienced supplier of components for aircraft seating. The company's PUR materials are ideal for tray tables and armrests, as they fulfill the highest aviation standards such as ABD0031 and FAR25.853b, and have a proven track record covering millions of air miles in service.

High performance and responsibility are the company's key goals, and its staff strive to meet the needs of customers by developing perfectly matched materials components.

With the PUR-foam product, Ebco is able to offer customers a very lightweight, yet hard and dimensionally stable aircraft passenger tray table with a long lifetime.

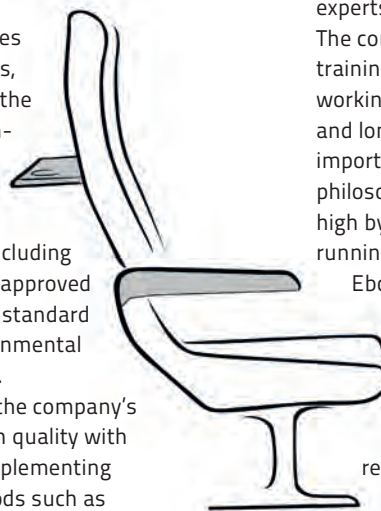
The single or bifold tables are available in many different shapes and printing can be applied in any color, such as logos, text and passenger information.

With a daily output of approximately 600 tray tables and more than 800 armrests, which are delivered around the world, Ebco can ensure high-end quality standards for customers.

The company can supply entire assemblies, including all components, tested and approved in accordance with aviation standard DIN EN ISO 9100 and environmental eco audit DIN EN ISO 14001.

So what is the secret of the company's success? Ebco achieves high quality with motivated employees by implementing Toyota management methods such as Lean Management, Kaizen, 5-S, Kanban and Shop-Floor.

Ebco is proud of its staff, who include young, motivated junior employees, experienced senior staff, highly qualified



experts and optimally trained employees. The company strives to offer continuous training and to provide a pleasant working environment. The creation and long-term safety of jobs are an important part of Ebco's corporate philosophy, and team spirit is also kept high by involving staff in sports such as running or Nordic walking.

Ebco strives for effectiveness and efficiency with well-balanced employees by using Lean Management and sport.

The company wants to grow profitably, while always remembering that customers and staff are the top priority. ☒

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SEATING SUPPORT

A series of investments and innovations are underway at Geven, with the aim of supporting a booming aircraft industry

Italian aircraft seating and interiors supplier, Geven, is gearing up to help airframe manufacturers face the unprecedented ramp-up in the numbers of aircraft scheduled to leave their assembly lines in the next few years.

It is becoming increasingly apparent that aircraft manufacturers are struggling with the huge demand for aircraft the aviation sector is facing. With signs of strain already coming from suppliers such as the engine manufacturers, Geven is ready to step up to make sure that seat supply is not another problem.

Having already established itself in the seating market, Geven has planned its operations in line with market forecasts, and increased its output

capacity via a number of strategic investments. These investments include the addition of state-of-the-art robotic production machinery, capable of doubling the current output capacity at Geven's production facility.

The company has also introduced a new line of products designed to cater to a wide range of aircraft platforms. This line includes *Essenza* (pictured right), an ultralight economy seating product suitable for narrow-body operators.

Geven has also developed *Elemento*, a long-range economy seat with a focus on comfort and customization options; *Comoda Alta Quota*, an elegant premium economy seat; as well as a series of long-haul economy seats.



Geven is prepared and ready to provide seating for almost every aircraft platform, from Airbus and Boeing narrow-bodies, to the A330, A350 and A380, as well as Boeing B777s. ☒

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COMPOSITE PICTURE

When composite structures are required, there are advantages in working with a highly experienced partner

Passenger seating for business and first class cabins has evolved tremendously over the last decade. These premium seats have essentially grown from being larger versions of standard seats into comfortable places to work, sleep and live during the time spent flying. Today, amenities such as bars, showers and suites are all plausible elements of the customer experience.

When British Airways first introduced beds into its B777 fleet at the turn of the millennium, a marriage of composite furniture and seating technology emerged. AIM Aerospace in Seattle was – and continues to be – the largest independent partner in delivering composite structures exclusive to high-end seating platforms.

Tracing its beginnings to the mid-1970s, AIM has produced virtually every composite structure that can be found inside a commercial airline cabin. From closets to crew rests, AIM is highly experienced in stepping up to the demands of first class cabins and the

customers who fly in them. Today the company is a world leader in providing solutions for many seating manufacturers. The company can deliver a broad range of products from composite privacy dividers, seatbacks, shells, consoles and compartment doors, up to complex full-height monuments in support of the seating 'living space'.

This capability starts with the visualization of design, and continues through to the testing, certification and manufacture of the associated furniture. AIM's products are often delivered straight to the airline or OEM without passing through a seating facility. The company produces thousands of composite seat shells and hundreds of monuments annually for many of the world's largest seat suppliers.

With 1,000 employees in the greater Seattle area, AIM also supplies more than 20,000 OEM composite parts per month. From a simple contracted item, to a fully integrated monument, see what AIM Aerospace can do for you. ✕



PHOTO: "WE SHOOT" PHOTOGRAPHY, INDUSTRIAL DESIGN: ICE DESIGN

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Visit our website to view a gallery of the original A3XX cabin concepts

Airbus A3XX

When Airbus formally announced it was developing the world's largest passenger aircraft, the world took notice. Following that December 2000 declaration, the public began to get excited about the prospect of such an incredible flying machine; a double-decker dream that the average long-haul flyer could conceivably find themselves traveling on in the future.

Encouraged by rumors and teasers started by excited airline PR departments and circulated by an eager and curious media, the public – and cabin designers – dared to dream of what the A3XX experience could hold (the official name for the aircraft had yet to be decided).

Some predicted an experience akin to a flying ocean liner, with leisure facilities such as casinos, gyms, fast food outlets, spas, shops – even bowling alleys, rather improbably – while others imagined an experience closer to a giant sardine can, ferrying 900 miserable passengers between hub and spoke.

Airbus itself, and various design agencies, shared their visions for the A3XX, with many concepts focusing on spacious first class spaces featuring dedicated social areas and an impressive disregard for cabin density.

Rather predictably, the reality of the A380 would turn out to be somewhere in between the extremes. Launch customer Singapore Airlines opted for a conservative approach overall, although its first class suites impressed at the 2007 launch, even if they lacked the lavish social spaces of the concept visions. Social spaces did follow though, with Korean Air, Emirates, Qatar Airways and Etihad all fitting wonderful bar zones, Air France fitting a tablet-based art gallery, and Korean fitting a fantastic duty-free shop. One of the biggest

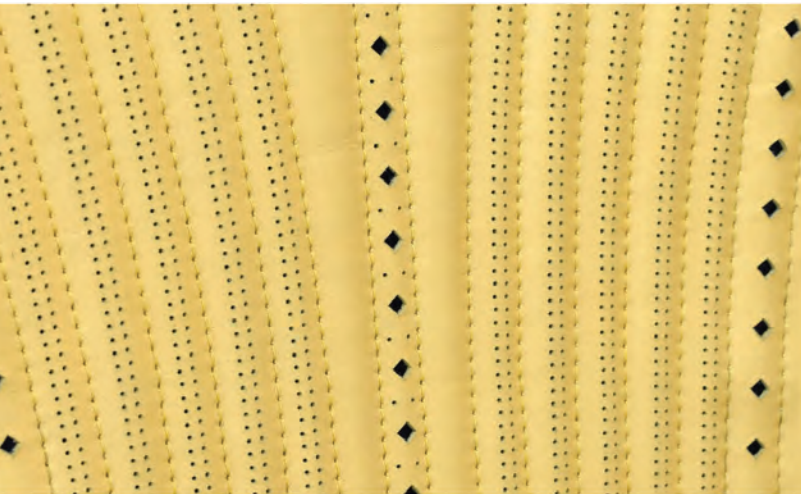
talking points remains the onboard showers, a remarkable experience enjoyed by first class flyers on Emirates and Etihad.

Throughout the project, the much-loved B747 was a benchmark of the Airbus design and marketing teams. As Bob Lange, head of market and product strategy at Airbus, told *Aircraft Interiors International* during the A3XX development program, "The B747 really shaped the democratization of long-haul travel as we know it today, so whether we like it or not, it's the benchmark against which we are being measured."

Indeed measurements played a key part in the A380's marketing, with comparisons against the venerable jumbo including 50% more usable floor area than a B747-400, and 32% more than a B747-8, 35-40% more seats in a typical cabin configuration, and an inch more aisle width and economy seat width. Passenger trials were claimed to show that the A380 was 50% more efficient than the B747 in terms of gate occupancy despite having more passengers, with a turnaround time of 95 minutes for 474 passengers, who took just 25 minutes to board.

The A380's launch was not without problems, being over budget and behind schedule, and an engine issue led to an early grounding of Trent-engined aircraft. Nearly 10 years on, the latest problem is a lack of orders, with production being scaled down to 12 per year in 2018 – quite a drop from the 27 deliveries in 2015 – but Airbus states that the A380's long-term future is secure. The A380 may not hold quite such a large a space in the hearts of the public as the iconic jumbo, but the huge potential of its vast spaces has earned it a special place in the hearts and imaginations of cabin designers. ✕

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