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ÖBB

The Austrian operator details new designs for long-distance day and night services

Safety

The increasing role of simulation in crash testing

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What the rail industry must do to remain relevant in the new transport ecosystem

Greater Anglia, UK ▮ InnoTrans 2018 preview ▮ Sleeper car design

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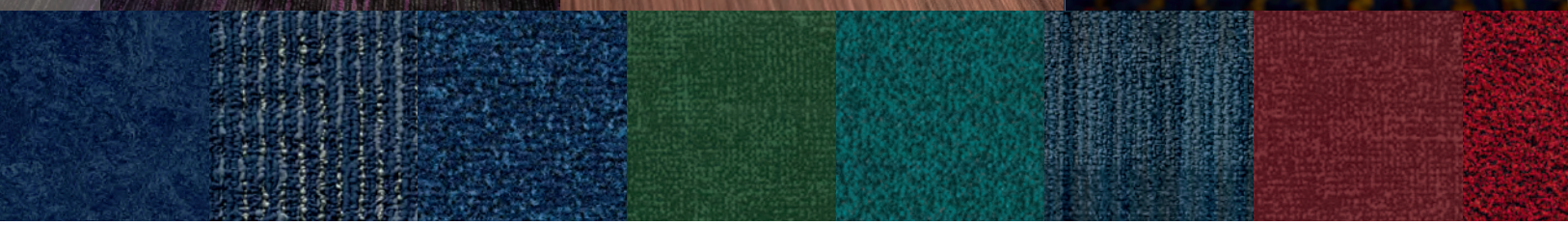

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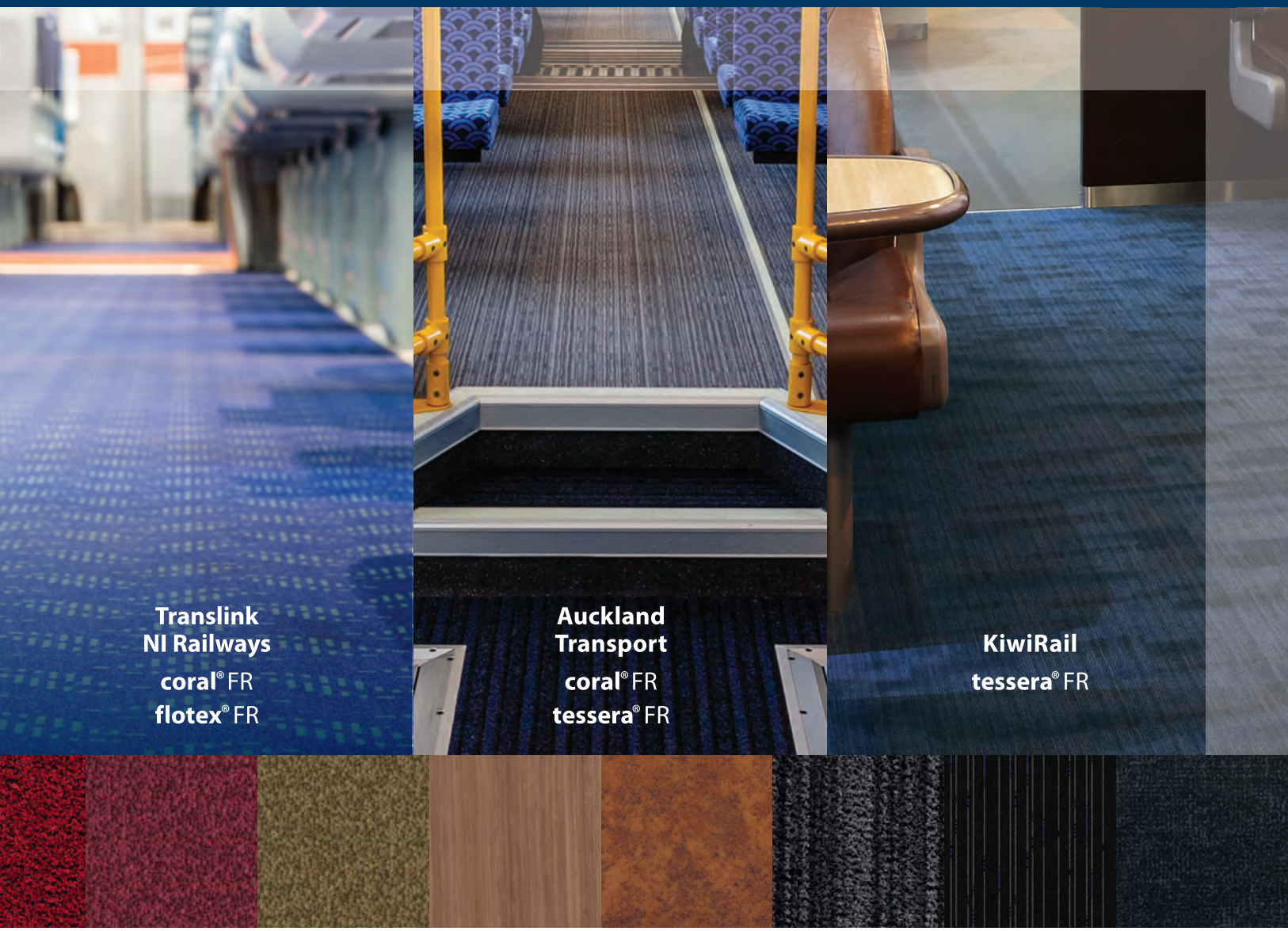

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PRODUCTS AND SERVICES

WELCOME

The eye-catching design on the cover of this issue is the result of a collaboration between BMW Group Designworks and Virgin Hyperloop One for the Dubai Hyperloop. When it enters service, the hyperloop should be capable of linking the UAE's Dubai and Abu Dhabi in 12 minutes – which seems a very short time to spend in such a beautiful cabin! Is the rise of such a premium service a one-off, or does it indicate an increase in passenger expectations?

On page 22 you can read an in-depth article exploring what the future holds for the rail sector, and how it may be expected to interplay with emerging forms of transport. Tom Allemeier, director of design at Designworks' Munich studio, contends that rail interior service needs to be improved "dramatically".

Passengers certainly have sky-high demands when it comes to sleeper services. "With air travel increasingly becoming a faster and cheaper way to travel, and high-speed rail gathering momentum, the question remains as to why someone would choose to travel on a sleeper train," says Weiwei He, rail lead and head of China business at design firm tangerine. "The answer is the experience. Sleeper services come at a premium ticket price and therefore passenger expectations for comfort, service, connectivity and convenience are high."

Alex Duncan, design director for interiors at JPA Design London, sees a strong future for this kind of service. "The thirst for unique experiences and occasions means that the luxury cruise train market looks set to grow, with indications that one or two new operations in unexpected locations could be announced in the not too distant future," he says. "While the appetite for nostalgia and romance remains as strong as ever, there may well be opportunities to also explore a different approach based, for example, on a more futuristic vision or one inspired by nature to appeal to the emerging generation of affluent customers."

We delve into the challenges involved in sleeper car design in the feature on page 38. Additionally, ÖBB opens up about the design for its new Nightjet sleeper service (as well as that for its new Intercity long-distance daytime service) on page 30. In fact, everywhere you look in this issue, improvements are being made that are aimed squarely at the needs of end customers – a very good sign for the future.

Izzy Kington, editor

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ISSN 1744-2281 (print)
ISSN 2398-0451 (online)
Railway Interiors International Annual Showcase 2018

Published by UKi Media & Events, a division of UKIP Media & Events Ltd

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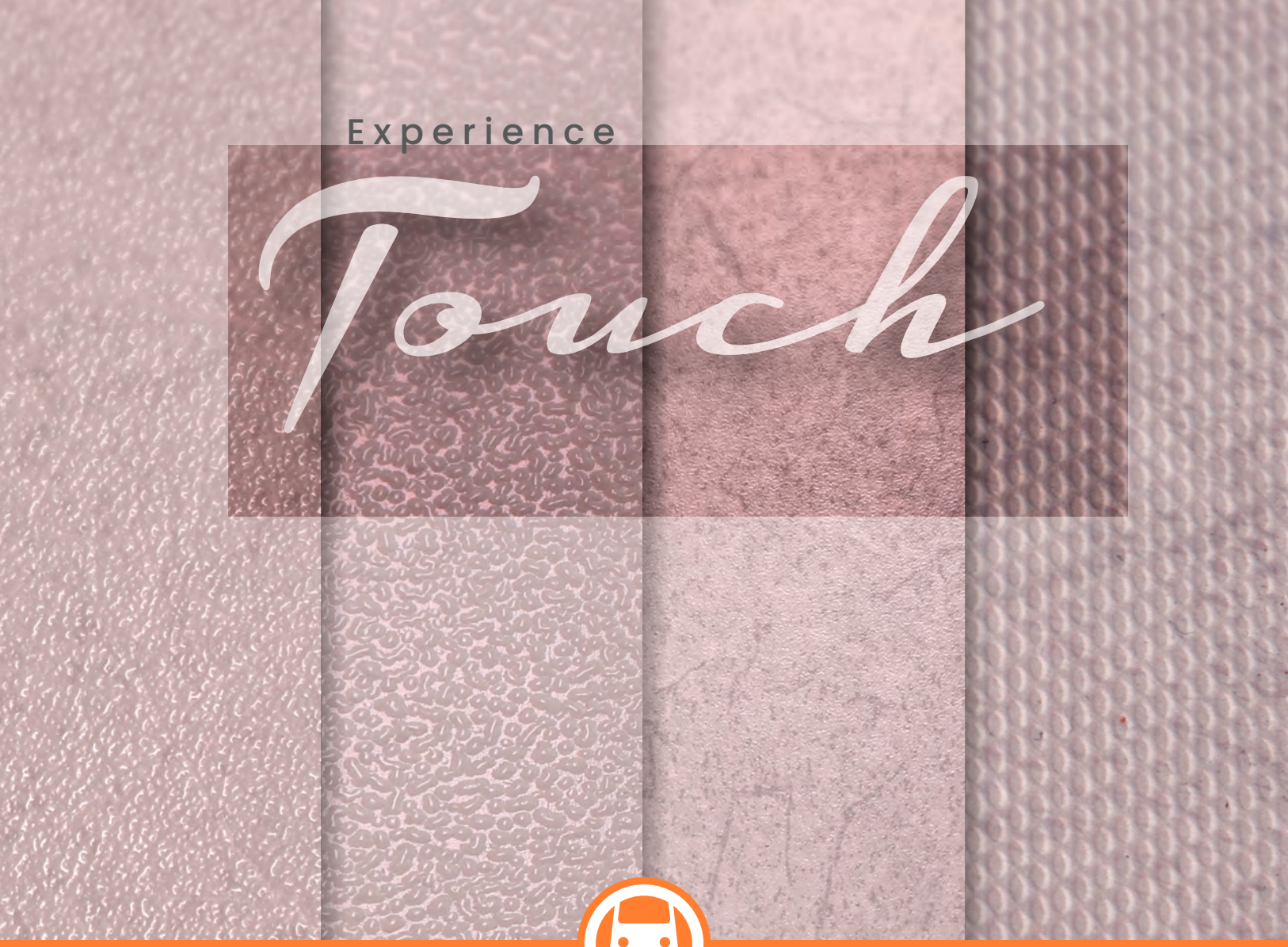
Printed by William Gibbons & Sons Ltd, 26 Planetary Road, Willenhall, West Midlands, UK.

Cover photo: The Dubai Hyperloop



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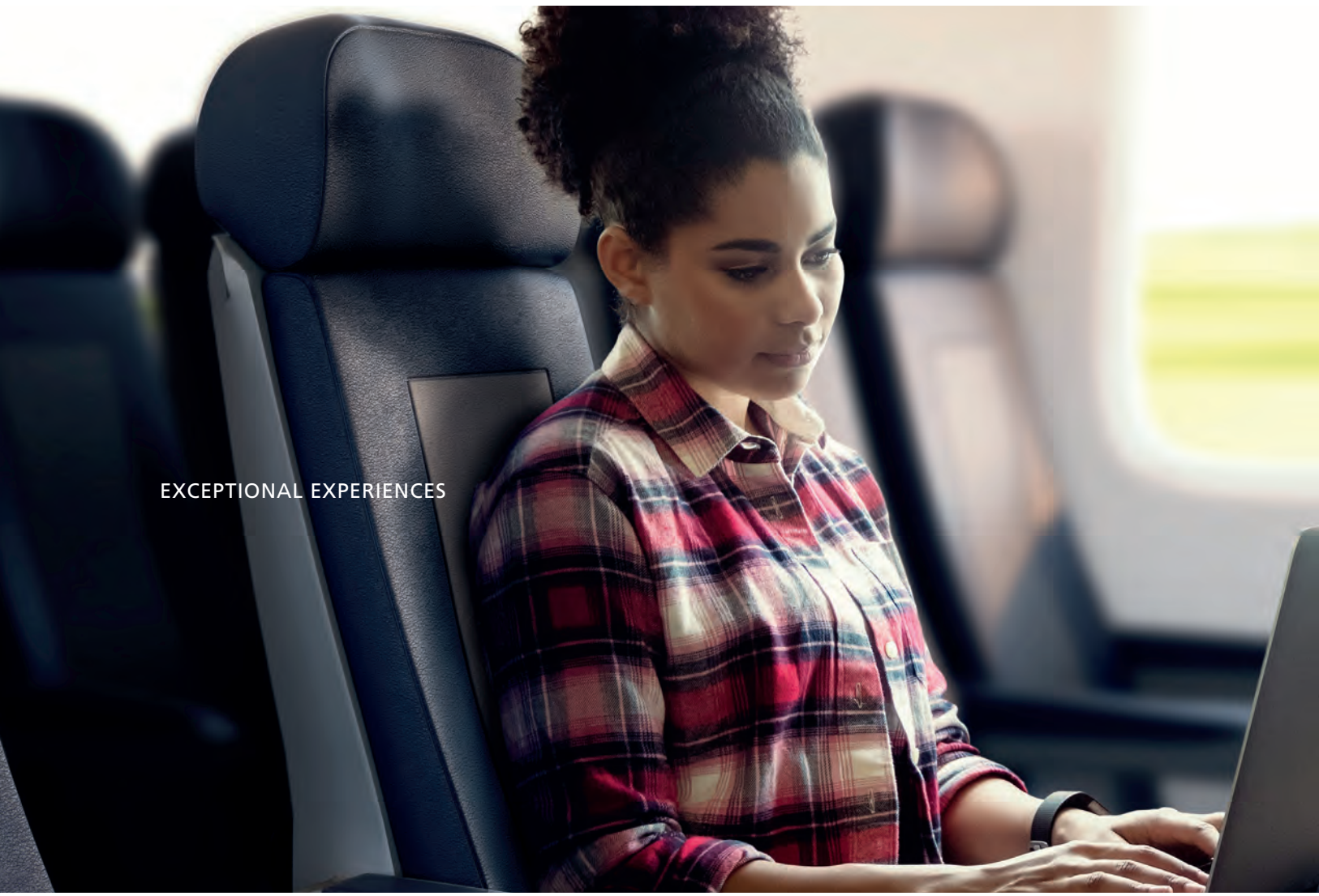

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Greater Anglia Anthony James

First class on Greater Anglia's new intercity train, an electric type from Stadler

Eastern enterprise

From 2019 passengers on Greater Anglia can look forward to more seats and fast, free wi-fi, as the operator starts to bring in more than 1,000 new cars

Connecting London with Cambridgeshire, Essex, Hertfordshire, Suffolk and Norfolk, the East Anglian rail franchise in the UK was awarded to Greater Anglia in October 2016. The nine-year franchise deal will see the replacement of the entire existing fleet with 1,043 new cars, 665 of which will be built by Bombardier in the UK and 378 by Stadler in Switzerland and Poland. The aim is to provide 20-40% more seats into London in the morning peak period, and 1,144 extra services per week on the network. All the trains are due to enter service by the end of 2020.

"Our bid team has agreed to replace every train that operates on the network, which has never been done before," notes Jason Brandon, who as brand manager for Greater Anglia is overseeing the design of interior and exterior finishes, fixtures and displays. "I saw a statistic the other day that there are 7,000 new cars coming into the UK by 2021 and that Greater Anglia makes up about 15% of those. We'll have the first new trains in service from May 2019, and then we have 18 months in which to roll out all the new cars while getting rid of the old ones."

IN NUMBERS: Stadler electric trains

10 intercity trains

10 Stansted Express trains

12 cars per train

2 classes on intercity trains, with 2-1 and 1-1 layout in first, 2-2 in standard

1 standard class on the Stansted Express, with 2-2 layout

759 seats on intercity trains

767 seats on the Stansted Express

6 cycle spaces on intercity trains

18 cycle spaces on the Stansted Express

5 toilets, including

1 wheelchair-accessible toilet

1 café bar on intercity trains

RIGHT: Standard class on the new intercity train

INSET: The same train's café bar

TIMELINE

October 2016	March 2017	November 2017	Q4 2018	May 2019	December 2019	December 2020
Greater Anglia is awarded the East Anglian franchise and sets out to replace the entire fleet	Online survey to gain initial customer feedback	VR experience launched to give customers a more immersive preview of the new trains	First trains due for delivery to Greater Anglia for testing	First trains due to enter service	Projected completion of customer information screen upgrades at stations	All new trains due to be in service

Greater Anglia is buying three new types of rolling stock: Stadler electric trains; Stadler 'bi-mode' trains, which switch between diesel and electric; and Bombardier electric trains. The 20 electric trains from Stadler will each have 12 cars. Half of these trains will be used for intercity services, and the others will connect Liverpool Street and Stansted Airport as the Stansted Express. Bi-mode stock from Stadler will be used for 24 four-car and 14 three-car trains. The electric Bombardier cars will form 22 10-car and 89 five-car trains.

Common purpose

With three train types from two manufacturers set to operate across numerous services, Brandon admits that instilling a sense of commonality has been the greatest challenge. "We have tried to align them as much as possible to give us more operational flexibility," he says. "We didn't want people getting on one type of train and taking the next and thinking, 'Oh, this is a different class of train.' The major difference is that one type [the Stadler intercity and Stansted Express] is longer and has more seats. Otherwise we've tried to use a lot of the same aesthetics, such as the color of the materials and the passenger information screens."

Brandon and his team worked to conjure a strong brand to conceal any differences. "Although there is a difference in the engineering in the full form of each train type, there is a clear brand identity that customers will definitely notice, which will hopefully tell them that they are traveling with Greater Anglia."

The starting point was the Greater Anglia color palette. "We then began to introduce additional textures to add warmth and depth to the environment," says Brandon. "We did this by introducing wood grains to end-wall panels and table tops, and metallic paint finishes to ceiling panels and luggage racks – both of which are now hallmarks of Greater Anglia train interiors."

Shades of gray

Given the predominately gray palette, an 'inside of a battleship' look was a risk. The team avoided this by using various shades. "We also went from dark to light, working from the floor to the ceiling, to add a sense of weight to the floor and a sense of space to the upper sections of the train," says Brandon.

When choosing carpets and seat covers, the team experimented with patterns. "We favor the cut/uncut moquette style as it's another way to get more texture while also giving the seat a longer life," says Brandon. "We ended up with a charcoal base color with flecks of red and grays, and combined this with a product from ELeather on the headrest. The result is contemporary and sumptuous."

RIGHT: Greater Anglia's brand manager, Jason Brandon, is heading up the interior and exterior design

Although there is a difference in the engineering in the full form of each train type, there is a clear brand identity

Jason Brandon, Greater Anglia

IN NUMBERS: Stadler bi-mode regional trains

24 trains with four cars

14 trains with three cars

167 seats on three-car trains, including **23** tip-up seats

229 seats on four-car trains, including **27** tip-up seats

6 cycle spaces

2 toilets, including **1** wheelchair-accessible toilet

LEFT: Passengers have been able to explore the trains – including this Bombardier model – using virtual reality

RIGHT: The bi-mode trains from Stadler will be used for regional services

Seating capacity for commuters is a national issue. There will be 20-40% more seats

Jason Brandon, Greater Anglia

Greater Anglia has encouraged Bombardier and Stadler to use the same interior suppliers for a consistent feel. However, this wasn't always possible. "A lot of the same suppliers are being used, but there are some major differences with seat suppliers because the layouts are quite different," says Brandon. "The Stadler trains have a 2-2 configuration, while the Bombardier commuter trains have 2-3 seating. We did look at using the same seats, but it didn't work."

Underfloor heating

An underfloor heating system favored by Bombardier meant that the same floor covering could not be used across train types. "A particular carpet was suggested for the Bombardier trains and it wasn't something we had used before," notes Brandon. "We had to do a bit of research into how that carpet was holding up elsewhere. We spoke to people that we knew across the business to check it wasn't wearing too quickly, and it was still looking good five years into service. The Bombardier trains use a heated flooring system, which limits the finish you can have because a vinyl would let too much heat through while carpet wouldn't let through enough."

To get around this, Bombardier uses a flocked floor covering from Forbo Flooring Solutions, designed to combine ease of cleaning and durability with the comfort, slip resistance and acoustic properties usually associated with textile flooring. Known as Flotex FR, it comes in more than 500 designs and colors and is digitally printed, enabling customers to match the floor precisely to their interior design scheme or corporate identity. "It's easy to clean and lasts a long time," notes Brandon. "On the Stadler trains, we chose a carpet from Tisca Tiara that gives a comfortable feel suitable for longer distance journeys."

Customer feedback

To help shape the interiors, Greater Anglia has gone to some effort to seek the views of its customers, carrying out research on existing services and even using virtual reality.

Passengers were invited to stations across the network to experience the new trains via a virtual reality headset while sitting in one of the new seats. Using the headset, customers were able to walk onto a station platform where one of each of the three new train types was parked. Once on board they could see the new seats, carpet, finishes, plug points and picture windows, and even visit the toilet, check out accessibility arrangements and walk to the bistro on the intercity service.

"We received more than 1,000 comments, most of which were very positive, but we also heard about some things that people weren't so pleased with," admits Brandon. "Generally, passengers aren't too fond of 2-3 seating, but we had to get a certain number of seats on the train to fulfill our commitment. We didn't want people to have to stand, as seating capacity for commuters is a national issue. There will be 20-40% more seats, depending which service you are on, which is fantastic. However, there were some things about the seats that were initially proposed that some people weren't too keen on, so that led us to push for a completely different seat, which was a great result."

Let's talk about Interiors!

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IN NUMBERS: Bombardier electric trains

- **22** trains with 10 cars
- **89** trains with five cars
- **1** class, with mostly 3-2 seating
- **1,146** seats on 10-car trains
- **544** seats on 5-car trains
- **4** cycle spaces
- **3** toilets, including **1** wheelchair-accessible toilet on 10-car trains
- **2** toilets, including **1** wheelchair-accessible toilet on 5-car trains

ABOVE: The Bombardier trains have a 3-2 layout to boost capacity on commuter services

LEFT: The operator's brand palette features a lot of gray and red

ONBOARD HIGHLIGHTS

Greater Anglia is spending £1.4bn (US$1.8bn) on its new trains: more than £500m (US$655m) on Stadler trains (financed by Rock Rail East Anglia) and £900m (US$1,179m) on Bombardier trains (financed by Angel Trains).

Features of both include air-conditioning, wi-fi, plug and USB sockets, and seatback tables. Notable upgrades from the existing service include the addition of cycle racks and new information screens on trains and stations, which indicate where there are empty seats. Thanks to the no-leg seat design, passengers can store their luggage underneath their seats.

Accessibility has been factored into the design in many ways – there are low floors and retractable steps to close gaps between the train and the station. It is also easy to pass between the carriages. All the trains feature a wheelchair-accessible toilet.

The intercity Stadler trains also feature an onboard café bar serving a range of food and drinks. Meanwhile, the Bombardier trains have electrically heated floors, meaning there is no need for sidewall heaters, which can encroach into passengers' legroom.

The seats will appear to float to enhance the sense of space. "We chose to cantilever all the seats and tables, which attach to the sidewall without the need for legs," explains Brandon. "This gives an enormous amount of extra luggage space but also allows our cleaners to pass through the train more quickly and efficiently.

However, the most surprising discovery from the passenger research was the need to align seats with windows. "I hadn't realized how much people care about seats being in line with the windows, so that was something that we had to double check, but thankfully we had a very good alignment already," Brandon says.

Tech touches

Asked to pick out a few favorite details, Brandon emphasizes some of the technological improvements on board. "It's a massive step up going from what we have now to these incredible digital passenger information screens that will have a wealth of information on them, including live seating availability throughout the train," he says. "Route maps will show where you are in real time and whether connecting trains are on time."

The investment is being mirrored by the installation of more than 1,000 new screens across Greater Anglia's 133 stations. They will display train running information in an easy-to-read format and will be much more informative when trains are delayed, as they will allow the control room to display custom messages.

Tech-savvy passengers will also enjoy much better broadband speeds and plenty of power points to recharge personal devices. "We had to make sure that the wi-fi was as good as it can get," says Brandon. "On top of that, if you have wi-fi, you need to have power, so every seat has plug points and USB charging. The Stadler train windows also have a fiber woven into them that boosts your cell phone signal, which is a nice little detail."


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The Dubai Hyperloop Passenger Capsule, designed by BMW Group Designworks and Virgin Hyperloop One

The future could see the rise of a more integrated transportation network - with big implications for train interiors

Future shock

ABOVE: The DB Idea Train even includes a gym with a digital fitness coach

RIGHT: Bike storage on the DB Idea Train

DB's new double-deck Idea Train concept includes zones for relaxation, gaming, children's play and watching sports events on TV

DB/UWE MIETHE

ABOVE: New ideas for entertainment are part of the DB Idea Train

For generations, railways have been in competition with other forms of transportation to attract passengers. But that conflict could be resolved as rail and its rivals are incorporated into a much larger transport ecosystem.

There's undoubtedly change on the way for every form of travel. Much of the reason for this is a switch away from cars for congestion and environmental reasons. In general, travelers are demanding greater flexibility and convenience.

Andy Brassington, head of engineering for mainline platforms at Bombardier Transportation, has a clear vision of this future. "Digitization is the means to achieve this so that there's an interaction between the train and other transport sources," he comments. "What we really need is a hub, so travelers can plan their entire journey with the modes available to them. This requires joined-up thinking at a national and international level as it has to include air travel as well as land-bound services."

Holistic experience

An even bolder future is laid out by Tom Allemeier, director of design at the Munich studio of BMW Group's Designworks. "The first thing to consider is there will be no 'rail customers' anymore, but people in transit," he says. "On part of these journeys, if it suits their travel agenda and expectations, people will use rail. Passengers will demand to be able to hop on and off."

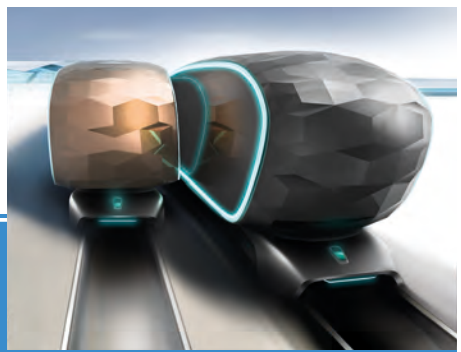
This would have big implications for the interiors expected on trains. "Passenger expectations of the interior will become independent of the means of transportation,

Rail interiors need to build up their service quality dramatically to meet the expectations customers have developed while using car, aircraft and bike services

Tom Allemeier, BMW Group Designworks Munich

ABOVE: For the Dubai Hyperloop Capsule, the Designworks team is targeting a premium feel akin to first class air travel

BELOW: The ANTS design by Siemens and Designworks



SIEMENS ANTS

The Siemens ANTS (Automated Nano Transport System) project has been developed with Designworks to explore how railways will integrate with other forms of transportation in the future. The project's key challenges included increasing the flexibility of rail, creating mobility on demand.

Borrowing ideas from autonomous cars, the ANTS uses self-organizing units that are 12m (39ft) in length. There's a traction unit to move the train, but the passenger cars can be configured with a high-density seating layout or with lounges, restaurants and even a sun terrace.

The journey that Siemens envisages could start with an autonomous taxi taking a passenger from their front door to the nearest ANTS station, where they can hop on board. The ANTS cars would arrange themselves into the most efficient train and choose the best route.

"If we want to motivate people to take the train, we need to make their journey more convenient," comments Jürgen Schlaht, head of innovation management for Siemens Mobility. "For the moment, the ANTS project offers ideas and visions to explore. Nevertheless, they show that railways still offer unforeseen potential for development."

so we need to understand their total journeys and the demands people have on these journeys," says Allemeier. "For design, this means stronger differentiation of the typologies of needs than we use today. To integrate with the total mobility ecosystem in the future, rail interiors need to build up their service quality dramatically to meet the expectations customers have developed while using car, aircraft and bike services."

A vision of the future

Designworks has been collaborating with Virgin Hyperloop One on hyperloop car interior development and has already created a prototype for the Dubai Hyperloop Passenger Capsule. Dubai's Roads and Transport Authority and Virgin Hyperloop One are developing the hyperloop to link Dubai and Abu Dhabu, UAE, in 12 minutes. The passenger capsule will have no windows, with mood lighting, leather seating and entertainment helping to create the premium feel expected.

It could be argued that new forms of transportation such as fully autonomous cars could encroach on one of the rail sector's current main advantages to passengers – the ability to use their travel time to relax or work. However, Allemeier says the majority of railcars have the advantage of space. "Trains are social spaces," he explains. "There is a huge potential in this, in making the train a place to be. One goal of traveling will not be to get from A to B, but to be on the train. We should start thinking of trains not as a means of transportation, but as a space."

LEFT AND INSET: Examples of flexible and modular interior options – including turnable seats and catering facilities – for Bombardier's Talent product family

RIGHT: The children's play area on the DB Idea Train

DB/UWE MITTER

We don't expect to see a demand for individual infotainment screens built into railcars the way they are in cars or aircraft

Michael Sohn, Bombardier Transportation

Flexibility will be key. "A challenge will be to offer every single customer the desired experience," says Allemeier. "This means more flexibility will be seen on trains. Zoning concepts will gain relevance. We'll also see the train develop further while in use. For this, a modular and flexible system needs to be introduced."

Adapt and thrive

The adaptability of interiors is a key consideration for Bombardier Transportation's Brassington. "We have to maximize furnishable space, which means moving electrical components to free up room," he says. "Wider gangways help with capacity and flexibility, so the saloon can be reconfigured during its lifetime. We're also looking at how to make reconfiguration possible during overnight maintenance periods, to suit the varying needs of the operator and passengers, so the car is future-proofed."

Some trains already offer onboard meeting rooms and business lounge facilities. On shorter routes, there's greater demand for seatback tables that can accommodate a laptop comfortably. "We know people want to stay connected, so providing more charging points and USB sockets is essential," says Brassington.

Limited roll-out

However, Michael Sohn, head of Bombardier's Center of Competence for Industrial Design, doesn't expect extra functionalities will be offered across the board. "We might see some individual work stations on longer services, but not on commuter trains," he says. "Good wi-fi is more important as passengers bring their own devices; this is also why we don't expect to see a demand for individual infotainment screens built into railcars the way they are in cars or aircraft."

SAFETY LEGISLATION

Perhaps one of the biggest selling points of trains as a mode of transportation is safety. Railcar structures often exceed the regulatory minimum standards for passenger and driver safety. "Railways are one of the safest ways to travel," says Andy Brassington of Bombardier. "By working to the highest standards of every market and striving to go beyond them, we can make railcar interiors even safer than they already are."

However, Brassington adds that universal standards would make life a lot easier for railcar designers, builders and operators. "Legislation concerning interior safety, fire, crash regulations and access varies across markets, from Europe to the USA to Australia," he comments. "A more common set of regulations would create a framework to work within for different suppliers."

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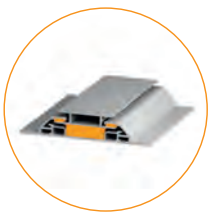

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RIGHT: The DB Idea Train has been realized in a 1:1 mock-up with 22 'theme worlds'

Sohn continues: "It's also unlikely we'll see fitness cars with gyms or children's play areas, as they take up a lot of space. An onboard gym would require showers and changing facilities. Perhaps this might be an option on exclusive trains for customers willing to pay extra during long journeys."

Space and weight

Sohn reckons the main focus for railcar interiors will continue to be fitting more passengers into the existing space while making the journey more enjoyable. Larger windows are one solution to this conundrum, although he points out this creates structural design challenges. "New materials will allow this, as well as reducing weight to improve efficiency," he says. "If we can make a small weight reduction on every seat in the car, it adds up to a large saving that contributes to a lower mass of train. In turn, that means lower operating costs based on track access charges; and lighter trains need less energy and maintenance."

Meanwhile, Brassington points out changes that are already happening to make rail travel a more enjoyable experience: "We're often asked to increase floor space on the body side where the heating usually is," he explains. "By introducing underfloor heating, it frees up space and also helps spread the heating across the whole interior."

DB and start-up SIUT have developed a light-emitting platform designed to speed boarding times by showing where doors and empty seats will be when the train arrives. It is already in use at an S-Bahn station in Stuttgart, Germany

LEFT: The light-emitting platform trialled by DB

While the rail industry is working to meet the demands of an operator, the rest of the mobility industry is working to meet the demands of end customers

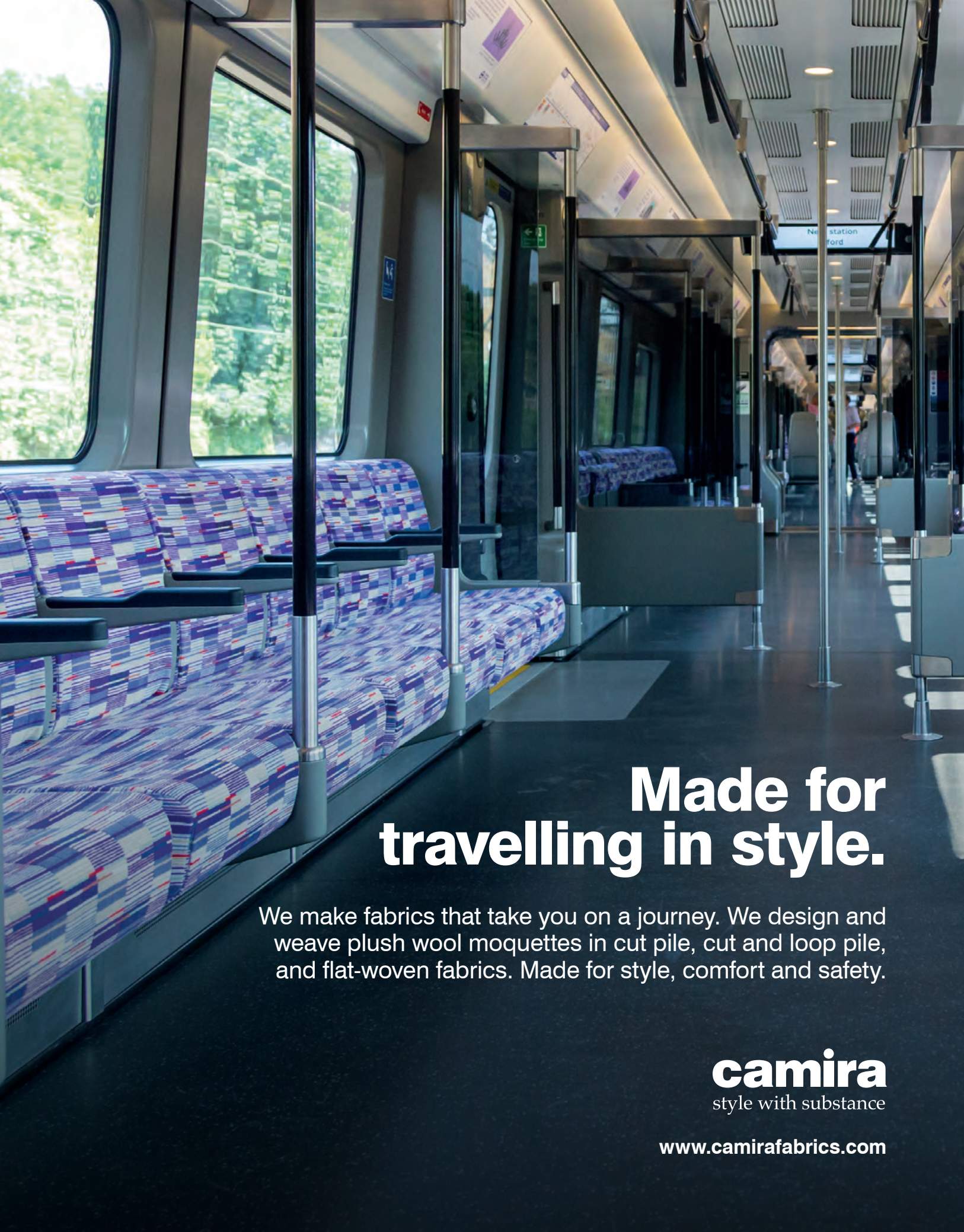
Tom Allemeier, BMW Group Designworks Munich

ABOVE AND RIGHT: Autonomous car concepts such as Renault's EZ-GO reflect a greater focus on car sharing

Seamless journeys

The thinking in the past has been to tempt passengers away from other forms of transportation, but now the goal is to make the total journey as seamless as possible. "The question of how trains can position themselves in car-free inner cities is a very intriguing one," says Allemeier of Designworks. "One of the main questions will be how intersections can be designed. How will we create a seamless experience between train rides and other inner-city transportation modes such as bike and taxi services? This comes with challenges, which include a shift from thinking as a monopoly to being part of a hugely competitive system."

Allemeier also believes the rail industry should take note of the way other industries put the traveler at the center of the design. "While the rail industry is working to meet the demands of an operator, the rest of the mobility industry is working to meet the demands of end customers," he says. "In the automotive sector, we've started to build one-to-one relationships with end customers. A process like this will require a cultural shift within rail companies. Design has enormous potential to bring about such changes."



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ÖBB Marisa Garcia

With strong competition for passengers, ÖBB needed to offer something special on its long-distance day and overnight services

Day & night

Economy class on ÖBB's new intercity day train

MAIN: Six-person glass-walled compartments can be booked in any class cabin on the intercity day train

IN NUMBERS: Intercity day train

- 8 trains
- 9 cars – including 2 first class cars, 5 economy class cars, 1 control car and 1 multifunctional car
- 49 seats on the lower floor and 53 seats on the upper floor of each first class car
- 70 seats on the lower floor and 76 seats on the upper floor of each economy class car
- 64 economy class seats in the control car
- 3 PRM places, cycle storage and a bistro in the multifunctional car
- 2 private compartments per seating car
- 2 toilets in each car
- 238m (780ft) length

In creating new designs for its Intercity day train and Nightjet overnight services with Priestmangoode, ÖBB (Austrian Federal Railways) aims to take on rival modes of transportation in terms of affordability, productivity and convenience.

"We are tapping into fierce competition with new railway companies and the airline business," says Kurt Bauer, head of long-distance service at ÖBB. "We were looking for differentiation from other operators, and the train sets are a big part of that. Our main goal was to provide a really relaxing experience for our passengers – more than the feeling of being carried from A to B."

Kirsty Dias, director at Priestmangoode, explains that one aim, particularly with the cross-Europe night services, was to recreate the sense of adventure associated with a bygone era. "There is an element of excitement for passengers on these services," she says. "We're injecting some old-school grandeur into the design."

Golden age

This factor – combined with a desire to design something representative of Austria – strongly influenced factors including the choice of materials. "We looked at the traditional materials and craftsmanship of Austrian carpentry and leatherwork," says Dias. "That brings a certain level of quality to the interior, perhaps evocative

ABOVE: A first class seat on the day train, complete with a power point and a shelf perfect for resting PEDs

DIGITAL LOVE

Accommodating the digital habits of modern travelers was a critical design requirement. As Kurt Bauer explains, ÖBB focused on designing for digital change. "We clearly went the way of bring-your-own-device," he says. "We assume that in the future everyone will do everything on their mobile or other electronic device."

Therefore the focus was on how to connect these devices to the seats. "This starts with charging possibilities, including wireless charging," says Bauer. "We have plugs that can be easily changed if new standards arise."

The design is also optimized to enable passengers to work on laptops and tablets. "You can put your tablet in the upper part of the seat and you have a table on the lower part where you can put your keyboard," says Bauer.

Kirsty Dias of Priestmangoode says wi-fi connectivity, such as that offered on these services, is now seen as a necessity and helps create a business-friendly environment that differentiates rail over short-haul air travel. "If you can enhance the working environment on trains that's a huge advantage," she says.

ABOVE: Journey information is presented on a strip running along the bottom of the windows

TOP: First class on the day train. Seats were raised to enable luggage to be stored underneath

We didn't want the trains to be carbon copies of others in Europe

Daniel MacInnes, Priestmangoode

of that golden age of travel when there was more consideration in the use of materials, and perhaps creates an environment that is less industrial."

The design also had to have a distinct signature. "We didn't want the trains to be carbon copies of others in Europe," says Daniel MacInnes, associate director at Priestmangoode. "The design is uniquely Austrian. We also wanted to make it feel contemporary but home-like. Everything feels a bit softer, more relaxed, so you feel you are traveling rather than just sitting on a plastic seat with a very small cushion. It feels inviting, even in economy."

Fact-finding missions

To ensure that the end product would meet customers' needs, Bauer and Priestmangoode's designers traveled the routes served by the current product to observe how passengers interact with the space and identify 'pain points'.

"We did observation journeys on the day train and long-distance overnight services," says Dias. "We went to Venice in Italy and Cologne in Germany to experience the service ourselves and gain insights. For example, we saw families struggling to get large amounts of luggage on board. We saw how people were sleeping in seats. We also observed that some people were making short journeys on a long route, which gave us an opportunity to offer short-journey seating, for example."

More privacy

Passenger requests included more electrical plugs and privacy, both of which have been accommodated. The new day train design has two classes (Eco and First) – both of which feature glass-walled compartments that can be booked by groups. "We saw how families and other large groups of people might have to sit on either side of the aisle or in different parts of the carriage," says MacInnes. "This new space is a zone where six people can sit together around the table. It eases the journey; you don't have to disturb the rest of the train navigating to three different areas."

Bauer adds that the compartments reflect the wider goal to incorporate elements of bygone train travel that people really appreciated. "In the

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ABOVE: A first class compartment on the night train

We wanted to bring good things about the past into the future

Kurt Bauer, ÖBB

IN NUMBERS: Night train

- 13 trains
- 7 cars – comprising 2 first class sleeper cars, 3 economy class sleeper cars, 1 control car and 1 standard seating car
- 1 deluxe and 9 first class compartments, each with two beds, in each first class sleeper car, for a total capacity of 20 passengers per car
- 28 single-bed pods and 3 four-bed family compartments in each economy car, for a total capacity of 40 passengers per car
- 36 seats in the control car
- 84 seats in the standard car
- 6 cycle/ski storage spaces
- 205m (673ft) length

ACCESS FOR ALL

Various prototypes of seats and compartments were tested with passengers, employees and lobbying groups, including associations for people with reduced mobility. "We've invested a lot of effort in this seating," says Kurt Bauer of ÖBB. "We brought a lot of people into the design process and built mock-ups."

Features designed with accessibility in mind include the "very broad" entrance areas and low floor. Bauer says key areas to optimize for ease of use by people with wheelchairs were the toilets and the seating area where wheelchairs can be placed. "We also considered things like how to enable people with impaired eyesight to navigate the train as easily as possible," says Bauer. "All these issues were discussed with various lobbying groups and associations."

LEFT: The vestibule area is a generous space offering digital information screens and some perch seats

past 20 years, everyone has basically gone for bus- or airline-style seating concepts," he says. "We wanted to bring good things about the past into the future and at the same time incorporate all the necessary developments we've seen in the mobility market."

There is also a new 'sofa seat'. "You can lift up the armrest and have some privacy, or if you are with someone you know and would like to sit as you would on a sofa at home, you can lower the armrest," says Bauer. "Or if you're on your own, you can really stretch yourself out on the sofa and feel like you're at home."

Bags of opportunity

One of the biggest pain points observed was luggage storage. "Heavy luggage can be difficult to lift," says Bauer. "In addition, people don't want to leave their luggage on racks positioned away from them because they have a fear of it being stolen. It basically never happens in reality, but people worry about it. Our solution was to raise the seat a little, which as well as giving you a better view out the window, means that you can fit

luggage under your seat. This gives the maximum feeling of security that nobody can take your luggage away, and neither do you have to lift it above your head."

The aisle was also widened to enable passengers to move large bags around. There are also luggage racks at the end of each compartment. "People do take a lot of luggage with them on European trains," comments MacInnes. "It was a lot more than we thought it was going to be."

ABOVE: The night train's new sleeping capsules

INSET ABOVE: The four-bed family compartments

BELOW: There will be various refreshment options on board

The night journey

A pain point particular to the current night train is its use of foldaway beds. "They're quite old fashioned and also a source of noise," says Bauer. They were replaced with fixed beds in the new design.

FOOD FOR THOUGHT

The day train has a new dining car. "The current restaurant is restricted in terms of how you can use it, so we created three defined areas for the new one," says Daniel MacInnes of Priestmangoode. "You have more relaxed bench seating, traditional face-to-face dining and a contemporary sandwich-shop-style area. Everything is more open – the food is there to be viewed, not just in a plastic box. The space is a destination rather than somewhere you pick up a sandwich and leave. It's an integral part of the experience."

There are also vending machines in the vestibule and in economy cars. "For those who don't want to leave their belongings out of view to get a quick snack, there are machines conveniently close to one of the door entrances or one of the ends of the cars," says McInnes.

What has really changed in the last few years is that people want more privacy

Kurt Bauer, ÖBB

There are now three sleeping options. First class sleeper compartments fit two beds, with the lower one convertible to a seating area, and an en-suite bathroom.

As on the current service, there are 'couchette' cars, which can accommodate individual or group bookings. Each compartment will accommodate four people and feature beds, night tables, lighting and power outlets.

The third option is a completely new development – individual pod-style beds with adjoining individual storage lockers – inspired by Japanese pod hotels. "What has really changed in the last few years is that people want more privacy," says Bauer.

As well as offering privacy, Bauer says the design makes economic sense. "We can fit 28 of these pods in a car, so the price for this bed is not much higher than in today's couchette cars. As well as enabling us to sell more tickets, it gives customers the benefit of being able to afford a night train trip in a private atmosphere without having to pay a high price."

By offering this kind of choice, affordability and comfort, ÖBB believes it has everything it needs to compete when the trains enter service in 2021.

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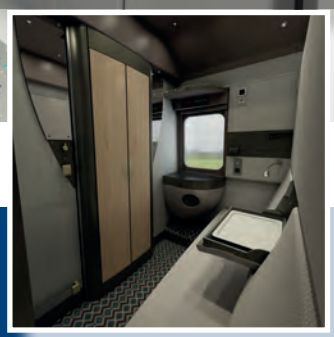

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Sleeping beauties

LEFT: JPA Design's most recent luxury sleeper cabin design, for the Belmond Grand Hibernian

Designers ponder the many challenges unique to sleeper car designs, from catering for many uses to a heightened expectation of luxury

While every railcar design project involves catering for a range of needs, the considerations multiply when passengers will not only sit in the car but spend the night there too. Many sleeper cars are also sold as a luxury experience, rather than simply as a mode of transport.

"The guest experience in luxury trains is based on the romance and nostalgia of rail travel from a bygone era, which requires opulent, beautiful and highly atmospheric interiors," says Alex Duncan, design director for interiors at JPA Design London. "As well as working out how to fit everything into cabins with a floor area of under 10m^2 [108ft^2], the challenge is to ensure that the experience compares favorably with a five-star hotel while complying with safety standards and weight constraints."

Seats and beds have various comfort requirements. To optimize both, design firm tangerine suggests that one solution could be a separate mattress that can be deployed at night. Matt Round, chief creative officer at the firm, also points out the challenges of accommodating different user groups and functionalities in a limited space. "For example, business travelers require somewhere quiet to work, while families need somewhere to be entertained," he says.

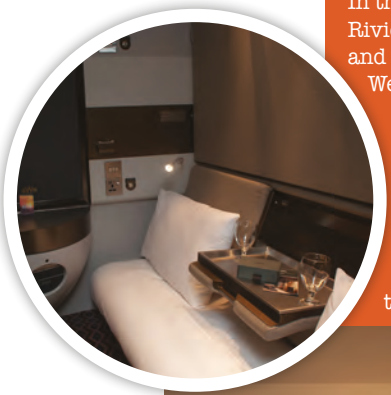
In the zone

"Differentiated spaces such as business corners, family areas and lounges are a possible solution on this kind of train," says Philippe Georgel, artistic director at MBD Design. "Passengers expect adaptive comfort, unique lighting, a social atmosphere and scalable privacy in a really secure environment. They want to use the journey to rest, work, enjoy culture, etc. The role of a designer is to answer these challenges and go

NIGHT RIVIERA SLEEPER

In the UK, GWR debuted new cabins on its Night Riviera Sleeper in 2017, and will bring in new lounges and menus in 2018. The overnight service links the West Country and London.

Technological improvements include USB charging points and plug sockets, keycard access, wi-fi and air-conditioning. Bottom bunks have been redesigned to convert into sofas for use during the day, and for improved storage underneath. The cabins also feature sinks, a bedside table, a waste bin and a wardrobe. Each train features one accessible cabin and toilet.



THE CANADIAN

In April 2018 VIA Rail Canada announced a C$46m (US$35m) investment to upgrade 25 railcars for the Canadian, a long-distance service. The work, to be carried out by Cad Railway Industries, includes updating the interior design, boosting seat comfort and making the cars ready for wi-fi.

"The work will extend over the next two years and create about 100 jobs at our Lachine [Canada] plant," says Fausto Levy, chairman of the board, president and CEO of Cad. "It will also result in large orders for components from our Canadian suppliers."

VIA Rail also recently awarded Bombardier a C$54m (US$41m) contract to upgrade 17 long-haul railcars to offer two wheelchair lifts, two accessible spaces with anchoring devices, an accessible washroom and display screens, including in the washrooms. VIA Rail says the new layout will comply not only with current accessibility standards, but also with future ones in development.

beyond, offering things such as catering, secure luggage compartments, noise isolation, dedicated charging and social areas."

"Security and comfort are passengers' first requirements," comments Régine Charvet Pello, CEO at RCP design global. "Passengers require personal safety, as well as security for their property. They also want physical comfort and the ability to rest, sleep and eat. The challenge is to offer an attractive, comfortable, individual and intimate solution in an extremely constrained space. The stairs to access upper berths and the ergonomics of opening the berths are some of the biggest design challenges we face."

Operator considerations

The additional demands on a sleeper train result in further maintenance requirements, points out Weiwei He, rail lead and head of China business at tangerine. "Operators need to maintain not only seats, but also beds, tables, dining equipment and accompanying amenities," she says.

She adds that operators should take the opportunity to create brand engagement at every moment, from online communication to the onboard meal service. "For example, amenities including a shoe shine service or suit press would help business travelers feel prepared and ready for their meetings, leaving a positive lasting impression of the overall service," she says.

On luxury projects, JPA Design has found sourcing suitable compliant materials a challenge.

"Because these exclusive projects are by their nature rare, and the volumes of materials involved are comparatively minimal, sourcing compliant and visually appropriate materials, fittings and fixtures requires a lot of effort," says Duncan. "Thankfully there are still a few artisans and specialist manufacturers who can create what is required, and a few fabric, carpet and leather manufacturers who will make bespoke and compliant products."

ABOVE: A sleeper car concept by MBD Design

TOP LEFT: GWR's Night Riviera Sleeper

LEFT: A concept by tangerine for an adaptable berth with a moveable partition, enabling flexible arrangements for families

BELOW: The DD Sleepers coach designed by RCP for Sofanor

BOTTOM: The new suite design on the Caledonian Sleeper

He adds that the substrates and paneling used for interior linings must be finished with specially formulated treatments that have to be tested and certified, while the result must look immaculate and withstand heavy use. "Here we rely on close collaboration with highly skilled fit-out contractors," says Duncan. "Additionally, the mechanics of elements such as fold-down bunks that convert into armchairs have to be designed and engineered to withstand the applicable crashworthiness criteria while offering the highest comfort, elegance and safety."

The outlook

In the future, tangerine's Round expects greater personalization to be delivered through digital touchpoints. "For instance, biometrics could be used for room access and windows could deliver journey information and additional services as interactive surfaces – even targeted for different user groups," he suggests. "Films could keep younger passengers entertained, business travelers could hold online meetings, and tourists could look at popular sites at their destination or go through their photos."

Duncan of JPA Design remains very optimistic about the future of sleeper trains. "There will be a move toward elevating the overnight experience both for those in cabins and those only paying for a seat," he says. "No longer will it be acceptable to share a bunk bed with a stranger or sit bolt upright all night in a standard seat. Cabins will be for individuals or couples, while seats will recline or even be fully lie-flat as in business and first class aircraft cabins. In Asia and other regions where huge numbers of passengers face long, exhausting train journeys, the push will be to elevate the experience by creating high-capacity, convertible and comfortable seating and sleeping facilities that offer some privacy."

CALEDONIAN SLEEPER

A fleet of 75 new railcars is on its way to refresh the experience on Serco's Caledonian Sleeper. The phased transition will begin in October 2018 on the Lowlander route between London and Glasgow/Edinburgh, UK. The cars, representing an investment of more than £100m (US$130m), are being manufactured by CAF.

New features include keycard entry, more accessible rooms, charging panels and wi-fi, while toilets, uniforms and the food and beverage offer have also been refreshed.

Accommodation options include suites with a double bed and en-suite, Club rooms with a twin or single bed and en-suite, Classic twin or single rooms, and Comfort seats.

Safety first

Advances in crash test and simulation techniques are helping to shape a new generation of railway interiors

Only commercial airlines can beat rail's safety record (and even then it could be argued that long-haul flights skew the statistics against shorter rail trips). Even so, the past 30 years or so have seen major advances in rail safety, driven partly by a growing emphasis on the passive safety of interiors.

In the UK, the current safety methodology began to take shape in the wake of the Clapham Junction rail crash of December 1988. As a result of a signaling fault, a crowded commuter service plowed into the back of a stationary train, resulting in 35 fatalities and more than 400 injuries.

One of the major consequences of this accident was that British Rail – as it was at the time – set out to adopt crash test procedures adapted from the automotive industry. It also looked to the seat regulations governing aircraft and buses. The research projects spawned by these investigations went on to influence rail safety regulations across Europe.

Safe structure

From a train-design perspective, the severity of an accident is determined by two main factors: the crashworthiness of the train structure and the secondary safety of the features within it.

"The industry's emphasis has been focused on maintaining the structural integrity of the bodyshell under foreseeable collision scenarios," says Hugh O'Neill, professional head of rolling stock at the UK's Rail Safety and Standards Board (RSSB). "Modern carriages feature crumple zones at the ends that are designed to absorb collision energy, and the passenger survival space is a rigid cell that should maintain its integrity. Couplers will shear off for anything other than low-speed shunt collisions, adjacent vehicles will come together, and anti-climb plates will engage to reduce overriding risk."

Horiba Mira can crash-test full-length train cars on a reverse accelerator sled

Maintaining this survival space and dissipating as much energy as possible are the first priorities, but next it falls to the design of the interior. One of the observations from the Clapham Junction crash was that seat designs are fundamentally only as safe as the mountings that hold them in place. It generally falls to the surrounding seats and tables to prevent the occupants from being thrown forward in a major impact. Therefore, these fittings should provide a degree of energy absorption, plus all edges must be radiused and the attachments for internal fittings should be ductile where possible and designed to prevent sharp points from forming if they do fail.

Glazing design

The most important aspect of containment, however, is the glazing; passenger ejection had previously been one of the main causes of fatalities in rail, bus and tram crashes. "All [UK] mainline trains must now have side windows fitted with triple-layer laminated glazing," O'Neil explains. "Studies have shown that this has proved very effective in terms of passenger containment in rollover accidents. Looking back, for instance, the old-style toughened glazing fitted to trams was implicated in a number of the fatalities of passengers ejected in the 2016 Croydon, UK, tram derailment."

It's also important to contain or prevent the movement of any objects within the carriage. Luggage racks are now designed to limit the lateral movement of bags and cases, while careful consideration has gone into the mounting of features such as fire extinguishers.

The fire safety of railway interiors has improved markedly in recent years

Hugh O'Neill, Rail Safety and Standards Board

Once the initial impact has occurred, the next priority is to minimize the secondary risks and facilitate evacuation or access by the emergency services. "The fire safety of railway interiors has improved markedly in recent years," says O'Neil. "Vehicles are now categorized as Operational Category 1 to 4 depending on how long they would be able to withstand a fire in a railway tunnel and what the emergency evacuation arrangements are. These categories are set out in a series of documented standards, which also cover the fire resistance of materials, the control of smoke and the reduction of toxicity."

Balancing act

One of the biggest challenges in the design of railway interiors – particularly when it comes to material choice – is finding a balance between these requirements. Some, for instance, have suggested that future-proofing against stricter fire safety regulations has led to the use of

LEFT: Horiba Mira says this kind of car-to-car testing is increasingly replaced by simulated testing

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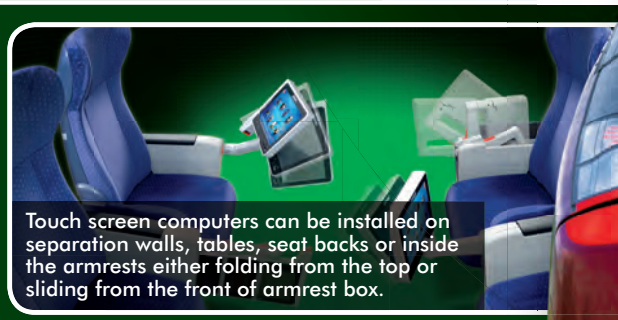

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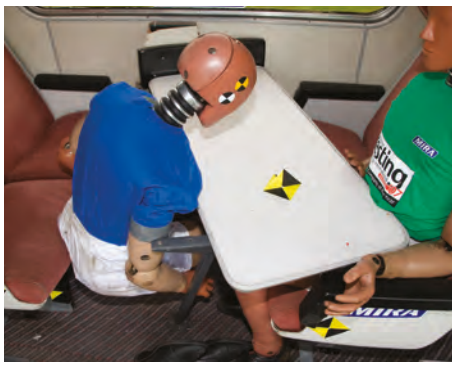
RIGHT AND BELOW: Tables and seats are important factors in an impact



THE BIG QUESTIONS

The design of a typical train car raises a few recurring questions. The dilemma of whether or not to fit seatbelts is perhaps chief among these. From a pure safety perspective, it would almost certainly improve matters, but things aren't quite as straightforward as they may at first appear.

For a start, one of the primary arguments for fitting seatbelts was to prevent people being ejected out of the train, but improved glazing has significantly reduced that risk. Likewise, clever seating design can minimize the chances of passengers being thrown forward in a crash.

Clearly, seatbelts would do an even better job, but they would introduce a range of logistical challenges for train operators. Airline cabin crew, for instance, are required to inspect every belt on a regular basis, and they carry spares on board each flight. Realistically, the resources aren't always there to do that on a train, even if people could be encouraged to actually use the belts.

Similarly, eliminating forward-facing seating and removing tables would almost certainly improve safety in theory. However, rail travel is already one of the safest forms of transport available and there is a risk that compromising its comfort and convenience could deter passengers.

A lot of work was done on the pulses and acceleration rates that a rail vehicle would see during an accident

Dr Tony Payne, Horiba Mira

RIGHT: Non-slip flooring is another important safety feature on board

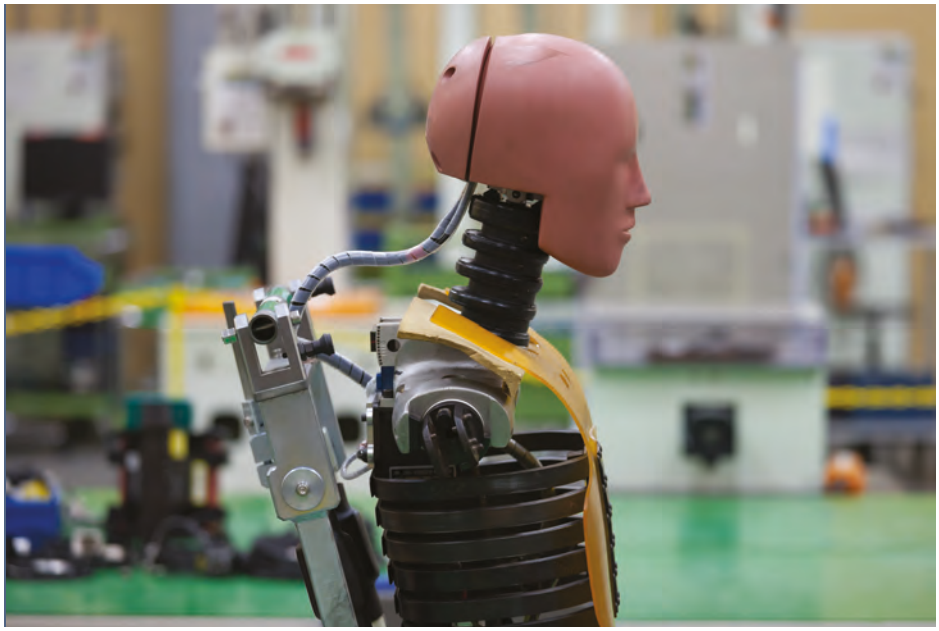
materials with lower energy absorption capabilities (although the RSSB states that this is not the case). Ultimately, fire safety remains a complex situation, and one where, following big strides in the past few decades, manufacturers and suppliers are now chasing incremental gains.

Test procedures

Physical crash tests are typically carried out at general-purpose test houses, often using equipment adapted from the automotive industry.

In the UK, one of the leading providers of crash testing services is Horiba Mira, which uses its HyGe reverse accelerator sled to generate a rearward pulse, mimicking the effects of a frontal impact. This is typically performed with small groups of seats, but the sled can carry a full-length half-side of a carriage. The seats can be mounted rigidly into the base of the carriage, but the preferred option is to mount them on load cell platforms. The forces involved can be considerable, with a pair of 101kg (223 lb) dummies traveling at 5*g* typically imparting a load of around two metric tons. The seat supplier can then pass this data on to the carriage manufacturer for use in its own quasi-static testing.

"A lot of work was done on the pulses and acceleration rates that a rail vehicle would see during an accident," says Dr Tony Payne, technical consultant in safety at Horiba Mira. "The actual acceleration rate for the original tests carried out in the UK was based on the 1991 Severn Tunnel rail accident, where a small DMU went into the back of express train. Interestingly, there were no fatalities, despite quite a high number of serious injuries, which seemed to suggest it lay more or less on the borderline of survivability."



LEFT: The automotive industry drove massive developments in crash test dummy technology

Non-instrumented 95th percentile dummies (weighing 101kg) are used for the structural integrity testing. These serve effectively as ballast. Meanwhile, fully instrumented 50th percentile (78kg/172 lb) Hybrid III dummies are used to assess the risk of injury, with particular attention paid to the head and neck loadings, plus the chest, abdomen, femurs and lower legs.

Use cases

One of the first considerations is which use cases to evaluate, says Payne: "You can have as many as 50 seating configurations in a train, so we start by picking out the worst cases – those that are likely to have the highest injury levels or the highest seat loadings. We would typically narrow it down to between six and 10 of these configurations."

Each of these cases is physically tested and the instrumentation within the dummies is analyzed to assess injury levels. All seats and tables must meet specified injury levels before installation into trains.

Simulation allows you to make design changes without repeating initial testing

Dr Tony Payne, Horiba Mira

BELOW: Simulated and physical tests of a seat

DUMMY DEVELOPMENT

Crash test dummies (otherwise known as anthropomorphic test devices, or ATDs) were first used in the aerospace industry, but it was the automotive sector that began to drive the development of complex, fully instrumented models in the 1970s. The Hybrid III dummy, developed by General Motors in 1976, set the template and remains the basis of most ATDs in use today.

Over the years, ATD technology has primarily evolved to suit the needs of the automotive industry, paying particular attention to the areas of the body that are especially at risk in a car accident. In the early 2000s the UK's Transport Research Laboratory set out to create a rail-specific variant known as the Hybrid III RS.

This dummy included additional instrumentation in the thorax, a unique abdominal unit to assess injury potential from table-edge impacts and a number of revisions to the internal joints and structures. It was successfully used in a variety of projects, including two full-scale crash tests carried out on behalf of the Federal Rail Administration in the USA.

These days, an increasing amount of simulation is used. In fact, in the rail industry, computer simulation can be used to homologate small changes, providing the fundamental design has been correlated against physical testing.

Simulation's role

The ability to use simulation is often a great advantage, but it's not necessarily the easy option, points out Payne: "You could usually carry out a number of physical tests for the cost of developing a proper computer model of a seat and correlating it against physical testing. In the long term, it can work out far more cost-effective, though, because it allows you to make design changes without repeating initial testing."

Much like the crash test dummies, careful attention is being paid to optimizing the computer models for rail use. It's unlikely that simulation will ever completely replace physical testing, but it provides a powerful and highly flexible tool for evaluating interior safety.

Trend on Track

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Show time

A guide to the rail interior highlights not to miss at InnoTrans 2018, September 18-21, in Berlin, Germany

S-BAHN DEBUT

The Siemens/Stadler consortium will present the first of the latest generation trains for the **S-Bahn** (light rail) in Berlin, Germany. The four-car, fully walkthrough DB Class 484 unit is due to enter service in 2021. The interior includes multipurpose compartments and a passenger information system designed to guarantee the latest in contemporary comfort. The classic exterior design is reinterpreted in shades of red, yellow and black.

Outdoor display, 10/400

NEW EVENT!

SOFTWARE DEVELOPMENTS

New this year is the hackathon, where software developers, designers and other industry experts will develop new ideas, for example for networked mobile solutions.

"The HackTrain initiative's goal is the digital transformation of the rail industry," says River Tamoor Baig, founder and CEO of **Hack Partners**, which is organizing the event. "InnoTrans is an incredibly exciting and energetic environment – and so is our hackathon. In the space of four days that is where computer solutions will be developed to tackle the biggest challenges facing the rail industry."

MATERIAL DEVELOPMENTS

PRODUCT LAUNCH!

At a newly designed stand based on its recently launched corporate brand refresh, **ELeather** will present some new product developments and a market first for the UK rail industry.

The company has worked in collaboration with industry-recognized designers to develop a number of interesting exhibits designed to broaden people's horizons as to the potential of ELeather's technologically advanced material, and to demonstrate the range's versatility in applications beyond seating.

VIP guests will be invited to a new 'inspiration room', where they can get early insights into the latest product developments and innovation projects, as well seeing the ELeather trend collection, which is due to launch later in 2018.

On top of that, the team is launching a low-smoke, leather fiber composite specifically designed to offer UK rail operators more choice in materials that comply with BS 6853.

Hall 1.1, Stand 206

NOISE ATTENUATION

People like to use their traveling time efficiently without being disturbed by noise. Moving fast but in silence is a challenge for train manufacturers. At InnoTrans, **Getzner** will present solutions to make the passenger cabin quieter. Sylomer FR, an EN 45545-2-certified polyurethane (PU) material, can be used to create floating floor systems that reduce structure-borne noise. The newly developed Isotop DZE Railway – an element made from stainless steel combined with Getzner's PU materials – reduces the structure-borne noise of HVAC systems and weakens strong amplitudes.

Getzner's vibration and noise reduction solutions have been in use for decades: the company says passengers benefit from lower noise and rail operators gain from lower lifecycle costs.

Hall 1.1, Stand 511 / Hall 25, Stand 213

APPROXIMATELY **3,000** EXHIBITORS ARE EXPECTED

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HIGH-SPEED TRAIN

A new high-speed train concept will be shown by **Siemens**, the latest generation of its Velaro platform. The Velaro Novo is designed for service from 250-360km/h (155-224mph) throughout the world. At 300km/h (186mph), the train uses 30% less energy than previous Velaro models, which translates to average savings of 1,375 tons of CO_2 a year. The train's weight was also reduced by 15% and passengers space was increased by 10%. The car body is based on the empty tube concept, meaning there are no permanent installations in the car and the interior can be furnished according to the customer's wishes.

The complete technical development has taken five years. Siemens says the first trains can enter service in 2023.

Highlights of Siemens' outdoor display will include the Avenio M articulated tram for Ulm, Germany; the Inspiro metro for Sofia, Bulgaria; the Cityval automated people mover (APM) for Line B of the metro in Rennes, France; the Desiro HC electric multiple-unit train for the Rhine-Ruhr Express in Germany; the Desiro City Moorgate for London, UK; the Desiro ML ÖBB cityjet prototype for battery operation; the Vectron MS locomotive for ÖBB and the Smartron locomotive.

Hall 4.2, Stand 202

EXHIBITOR IN FOCUS

Henri Chapelle, sales and marketing manager, Armacell

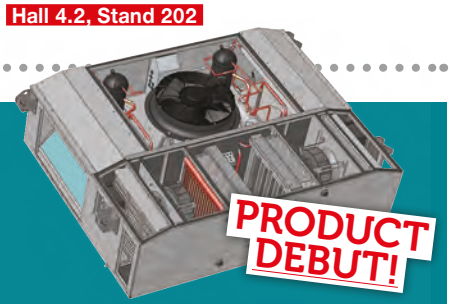
What are your plans for the show?
We will showcase various PET foam solutions for railway composite structures. Among them are our structural PET foam core range, ArmaForm Core, which is increasingly used in applications including component floor panels, body structures, doors and partition walls.

What challenges do you overcome to meet customer requirements?
Today's train operators and manufacturers are challenged by the need for even lighter, more energy-efficient and environmentally friendly trains without compromising safety and durability. With ArmaForm Core we offer a structural PET foam core combining light weight, high mechanical strength, maximum service life and trouble-free maintenance.

What are its advantages?
Beyond the mechanical attributes, fire, smoke and toxicity performance is a top priority in public transport, even more so when trains operate in tunnels. One of the big advantages of ArmaForm Core is its very low smoke and toxicity levels when subjected to fire. Official testing has shown that ArmaForm-cored sandwich structures, in combination with appropriate laminates, achieve the highest classification, HL3. Even without laminates, ArmaForm passes the EN 45545-2 standard, for example HL2 for R10. Although the standard is not intended to be applied to the core material only, it clearly shows the potential of using ArmaForm in railway applications that need to pass the most stringent hazard requirements.

What trends have you noticed in terms of demand and application?
Environmental aspects are another priority for the rail industry. Today, designing and manufacturing eco-friendly trains also implies consideration of how the processed materials are manufactured. Armacell is the inventor and owner of the patented r-PET process to manufacture PET foam cores from 100% post-consumer PET materials (recycled beverage bottles). A lifecycle analysis has shown that ArmaForm core material outperforms other foam cores in terms of environmental benefits. Compared with standard (virgin) PET foam cores, its recycled raw material base reduces CO_2 emissions by 33% during the foaming process. ArmaForm is a cost-effective and sustainable foam core solution.

Meet the Armacell team in Hall 8.2, Stand 112



AIR-CONDITIONING

Plant Ekvator will premiere its ABK-25 autonomous air-conditioner, a retrofit solution offering heating, cooling and ventilation modes. It has two refrigeration units based on hermetically sealed compressors with air-cooled condensers. Air is heated by the electric heaters built into the air-conditioner and the water air heaters. The air-conditioning is controlled by the railcar's automated control system. If the outside air temperature falls below -15°C (5°F), only the electric air heaters are used for heating. The ABK-25 uses R410A refrigerant and is designed for temperatures from -40°C to 45°C (-40°F to 113°F).

Hall 5.1, Stand 100

MORE THAN
100,000
TRADE VISITORS ARE EXPECTED TO ATTEND IN 2018

DESIGN FLOORING

NEW RANGE!

The design team responsible for **Forbo Flooring Systems**' Flotex range has partnered with many famous designers over the years with great success. For example, one project involved creating six striking flooring designs inspired by Vincent van Gogh's paintings.

Further to this, Forbo entered an exclusive design collaboration with Sottsass Associati, to bring to life four avant-garde designs clearly carrying the latter's signature, using Forbo's flooring and precision HD printing techniques.

The next project, the HemingwayDesign x Forbo Flooring Systems collaboration, played with pattern and shape using Forbo's product to create strong, graphic patterns and geometrically stimulating designs.

Not stopping there, Forbo teamed up with British design brand Tibor on an exciting new range for Flotex.

"Pioneering textile designer Tibor Reich was a man ahead of his time," explains Huw Arthur, marketing coordinator at Forbo Flooring Systems. "Although these striking patterns date from the 1950s, they could have been designed yesterday. Flotex provides the perfect medium for Tibor's dynamic graphic designs. The cutting-edge technology of digital printing gives a new lease of life to his arresting patterns."

Forbo's latest partnership is with Philippe Starck and has resulted in a new collection of floor covering systems called Flotex By Stark.

When printed on Flotex FR, rated HL2 according to the EN 45545-2 standard, all featured designer ranges are available to be used on board trains and provide exciting designs to deliver a wow factor.

Hall 3.1, Stand 322

THE SHOW FEATURES FIVE SEGMENTS: RAILWAY TECHNOLOGY, RAILWAY INFRASTRUCTURE, PUBLIC TRANSPORT, INTERIORS AND TUNNEL CONSTRUCTION

OPERATORS IN ATTENDANCE

There are currently 22 transport companies due to attend, representing countries including China, Germany, Kazakhstan, Japan, South Korea, the UAE and Ukraine.

They include the **Road & Transport Authority Dubai** (RTA), which is working on projects including Route 2020, the Red Line metro expansion, the Hyperloop and the Dubai Metro Green Development.

Another highlight will be **DB**'s Idea Train, a futuristic concept that incorporates areas for sports, work, public viewing and relaxation, as well as premium-class compartments. "Our aim is to inspire public transport buyers and convince them to incorporate innovative and customer-oriented ideas in their future calls for tender," says Prof. Dr Sabina Jeschke, member of DB's board for Technology and Digitization.

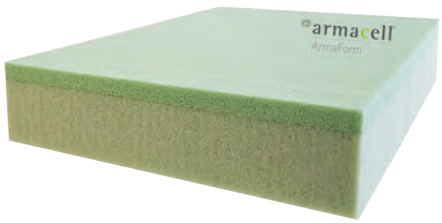
Other operators in attendance include first-time exhibitor **Keolis**; Polish network **PKP**, which will occupy an entire hall at the show; and **RB Rail**, which is coordinating the Rail Baltica project, an envisaged line connecting Warsaw, Kaunas, Riga and Tallinn.

SANDWICH SOLUTION

ArmaForm MultiCore, part of **Armacell**'s PET foam core product range, replies to the railway market's demand for a multiple core design, combining different densities in one foam core to improve impact and point load resistance while keeping weight to a minimum.

A key requirement of exterior and interior rail sandwich applications is impact resistance. Important factors to optimize the impact performance and resilience of the sandwich structure are the core materials' compression strength, ductility and adhesion to the skins. Armacell says that with ArmaForm all these requirements are met – and that comparative testing shows that an ArmaForm-cored sandwich structure can outperform traditional concepts such as honeycomb, as well as balsa-cored structures.

ArmaForm Core is made from thermoplastic, enabling novel ways of processing. "It is known that by using a layered core material with different densities, properties can be improved when it comes to impact and point load resistance," says Henri Chapelle, sales and marketing manager at Armacell. "However, the extra cost and weight of bonding the core sheets together with an adhesive often offset the advantages gained. With the thermoplastic welding process used for ArmaForm MultiCore production, you can economically and safely achieve bonding without the grooves/



perforations and adhesive normally required, and obtain a uniform and well-controlled bond line every time. Recycling is even easier, because no other material is mixed into the ArmaForm MultiCore material."

Chapelle offers a comparison of an ArmaForm Core with a uniform density of 115kg/m³ (7 lb/ft³) against a multicore solution with densities of 200kg/m³ (12.5 lb/ft³) for the top layer and 70kg/m³ (4.4 lb/ft³) for the bottom layer. "The multicore solution is 13% lighter, with double the energy absorption for an impact load and a 30% increase in screw retention," he says. "This combination is ideal for applications including flooring and nose cones. Different densities have different advantages, so ArmaForm MultiCore can be tailored to suit."

Hall 8.2, Stand 112

DESIGNED FOR A GREENER TOMORROW

ArmaForm®

Made entirely of recycled PET bottles, ArmaForm is the benchmark for a sustainable, 100% recyclable alternative to legacy foam core materials.
Thanks to its unique combination of saving potential, environmental benefits and its excellent mechanical and FST properties, it is ideal for usage in railway composite structures.

- // Very low smoke & toxicity levels
- // EN 45545-2 compatibility
  HL2 foam alone
  HL3 with skins
- // Excellent thermal insulation properties
- // Optimum long-term stability

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Safe investment

The Cellobond product range is used to create EN 45545 HL3-compliant lightweight composites, and was recently improved to minimize formaldehyde and improve manufacturing efficiency

At InnoTrans 2018, to be held in Berlin, Germany, on September 18-21, 2018, Hexion will present two product ranges, showcasing the breadth of its expertise as a supplier of materials for the rail industry. First, it will launch the Bakelite product portfolio for brake systems. Hexion's Bakelite resins are used to manufacture friction products for rail braking systems to meet upcoming European regulation intended to reduce noise while improving safety and wear performance.

The company will also showcase new parts from Siemens and Hitachi Rail that were manufactured from its new Cellobond ultra-low free (ULF) formaldehyde phenolic resins and gel coat to comply with the European EN 45545 HL3 fire, smoke and toxicity (FST) standard.

Fire retardancy

The range of Cellobond resins is used to make composite parts for inside and outside railcars. Sara Frattini, global market segment leader at Hexion, says that this phenolic range has many

MAIN AND RIGHT: The range of Cellobond phenolic resins is used to make parts meeting EN 45545 HL3, required for European trains traveling underground

POTENTIAL APPLICATIONS

There are numerous ways in which Cellobond resins can be manufactured and deployed. Inside train cars, Cellobond resins have been used to form parts for ceilings, flooring, side panels, window surrounds, standbacks, luggage racks, drivers' desks, toilet modules and heat shields. Externally they have long been used for train fronts, roofs and doors.

The Cellobond resins are suitable for a wide range of manufacturing methods, including vacuum infusion, resin transfer molding, hand lay-up, compression molding, hot press molding and pultrusion.

RIGHT: A toilet module part created by Alte Technologies from Hexion's Cellobond ULF resin

advantages over polyester systems. "Phenolics are intrinsically fire retardant – they do not need fillers, fire retardancy treatments or intumescent gel coats to meet the most demanding standards, such as EN 45545 HL3," she says. "This means fire safety is always ensured, whatever manufacturing process is used. By contrast, highly filled polyester systems require intumescent gel coats and more fire-resistant painting systems to pass the most demanding FST requirements. In addition, filled polyester systems present difficulties in resin transfer molding or vacuum infusion because the formed parts may not have uniform fire retardancy and are not cost-competitive."

The Cellobond product line is used in applications where fire safety is a priority. Hexion holds approvals for the product in the aerospace interior, building and automotive markets. The range has passed demanding fire tests for new applications in electric vehicles. Frattini says Cellobond resins also provide sustainability benefits through their light weight, which reduces energy/fuel consumption. She says that compared with highly filled resin systems, phenolic resin-based composites can be 10% lighter or more.

Recent upgrades

The parts on display at InnoTrans will showcase Hexion's ULF technology, a recent development made to address concerns in the industry regarding the use of formaldehyde. "With all our resins,

Phenolics are intrinsically fire retardant – they do not need any fillers, fire retardancy treatments or intumescent gel coats to meet the most demanding standards

Sara Frattini, Hexion

LEFT: Cellobond resins have been used to create parts used on London Underground train cars

the free formaldehyde content is now below 0.1%," says Bernd Wellhaus, European sales director at Hexion. "In 2017 Composites UK gave us the Health and Safety award in recognition of quantifiable improvements that go beyond the legal requirements."

Hexion has also recently expanded its portfolio of ultra-low free formaldehyde emitting Cellobond resin products to include a cost-saving gel coat and fast-drying pre-preg resin. Cellobond ULF GC84-500, a gel coat based on ULF phenolic technology, allows direct painting on composite parts without surface preparation, which Wellhaus says saves up to 30% production time compared with before. A further product, Cellobond ULF PS90-204, is a pre-preg resin designed to deliver faster drying speeds. As with the rest of the Cellobond product portfolio, Cellobond ULF GC84-500 and Cellobond ULF PS90-204 have been designed to meet the most demanding fire safety standards, including EN 45545 HL3 for trains and FAR 25.853 for aircraft.

Happy customers

One recent Cellobond product convert is Alte Technologies of Parets del Vallés, Spain, which adopted Cellobond ULF resins for the manufacture of toilet modules on all its new projects – including for the NS Sprinter Lighttrain in the Netherlands, and for Greater Anglia and South Western Railway in the UK.

Cellobond resin technology was new to Alte and a period of adaptation was required for staff. One of the differences, for example, is that the surface paste is different from the one Alte had been using, and a pigment had to be added. However, Alte reported that Cellobond ULF resin technology enabled it to meet demanding fire and smoke standards and ensure a safe process for its staff. Alte has had positive feedback from its customers and intends to continue using Cellobond ULF resins, saying the advantages are remarkable compared with the technologies previously used.

RIGHT: Alte Technologies has adopted Cellobond ULF resin to make all its toilet modules

Another customer, FTI in the UK, chose Cellobond ULF J6021 X01 for its FibaRoll PH SMC (sheet molding compound), used to mold parts according to London Underground's S-1085 specifications. FibaRoll PH SMC has been developed for use in compression molding where fast, high-volume processing is required. It met and exceeded the FST requirements for London Underground and also passed British Standard BS6853 and EN 45545 HL3. FTI reports that the parts had an excellent surface finish straight out of the mold, minimizing the amount of finishing required prior to painting.

Meanwhile Datum, a UK supplier of composites, uses client-approved phenolic resins for manufacturing cabs, passenger information screen covers, universally accessible toilet modules and valances for UK train projects including the Elizabeth Line, London Overground and Greater Anglia. The company uses a variety of methods, including hand lay-up, compression molding, hot press molding and vacuum bagging.

Cellobond resins were selected to meet stringent British fire requirements, and for their reliability and proven performance in service. Datum says that phenolic resins are a stable material and suffer no shrinkage in service, are unlikely to distort on hot days, also making them ideal for insulation and exhaust shielding.

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Fashion forward

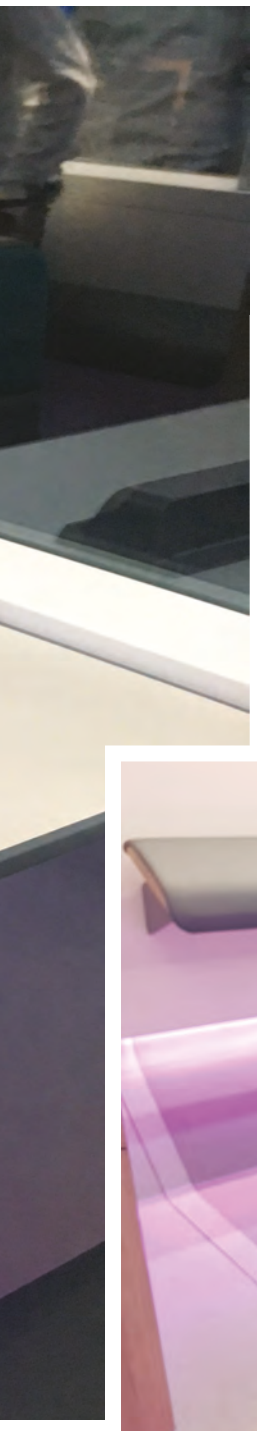
Recognizing that design is now a critical factor in improving the passenger experience, ELeather is updating its range and making things easier for designers

Over the past eight months, leather fiber composite supplier ELeather has been working closely with an external design consultancy, TrendWorks, to understand the latest trends in colors, materials and finishes. As well as aiding the creation of a completely new trend collection, ELeather says the process has also helped it to really understand what passengers want, and what tools it can provide to designers to help them specify ELeather products more effectively.

As well as the markets it already serves – aviation, rail, bus and coach – ELeather also examined trends in the automotive and lifestyle sectors. "We wanted to consider other markets, including lifestyle, because although we're not in the business of making luxury leather goods yet, a lot of the trends – especially in terms of surface textures and colors – start in the fashion world and filter through to the other industries," says Nicola Rapley, marketing communications manager at ELeather.

Comprehensive research

"We looked at various channels – including design shows, other industry trade shows, magazines, festivals, seminars and blogs – to determine what we think are going to be the main trends over the next couple of years," says Rapley.



LEFT AND BOTTOM: ELeather-upholstered seating in the dining car on DB's Idea Train, showcasing a variety of textures

BELOW: ELeather is also used in first class on the DB Idea Train

Train design is now being approached more from the passengers' point of view

Nicola Rapley, ELeather

From those trends, ELeather explored the ones it felt were most relevant to its capabilities and the markets it serves. Using these insights, the company created five new textures for its grain finish range. These include Powdery Soft, which has a matt, almost nubuck suede-type feel. Refined Elegance has a fine grain that could be imagined on a luxury handbag. Deep Natural is a deep grain that Rapley describes as giving a more organic, distressed feeling that works particularly well on extra-large surfaces. Soft Volume has a natural looking but structured texture that gives a feeling of volume. Finally, Graphic Relief provides a more technical, almost geometric pattern.

"We had 17 grains to begin with," notes Rapley. "Our intention wasn't to make the range bigger, but instead refine it to a more diverse selection."

Quality control

ELeather's eponymous product is made from a composition of leather fibers. Grains are applied using transfer papers rather than embossing, which allows more flexibility in production and the ability to trial new grains more easily.

The company also created 21 new colors for its range. Rapley notes enduring appeal for blues and grays, but says brighter, more unusual colors – including the updated range's teal and coral options – are often the ones that grab people's attention first.

Easy pickings

Another aim of the research was to make the specification process easier for customers. As well as looking at best practice across the industry, ELeather sought feedback from designers. "The feedback indicated that the way we allow people to specify our products wasn't that straightforward," says Rapley.

ELeather has thus simplified its product naming convention to a four-digit code for each color and grain combination. It has also redesigned swatches to remove their edging. "The new swatches are now much easier for customers to use on a mood board, or if they need to put the swatch up against another color or product edge to edge," says Rapley.

Overall, Rapley says, the project has helped ELeather to respond to an increased focus on design and comfort in the industry. "Train design is now being approached more from the passengers' point of view," she explains.

RIGHT: ELeather says its product is a good choice for premium seating – as pictured on the DB Idea Train – because it retains its aesthetic quality in service

ELeather's new collections will be shown for the first time to the rail industry at InnoTrans 2018, in an invitation-only VIP inspiration room

This passenger-centered approach is not purely about aesthetic options. "A passenger's perception of comfort could be based on the seat's cleanliness," says Rapley. Nico den Ouden, sales and marketing director at ELeather, contends that the company's leather fiber composite has the advantage in this regard. "Fabric upholstery is not necessarily the most hygienic or easy to maintain option," he says. "Longevity in service is a big consideration for the industry."

ELeather prides itself on the quality and look of its product even after years of service. "Traditional leather has a tendency to wear more and go saggy over time, whereas our leather fiber composite isn't subject to that sort of stretching and bagging so it looks better for longer, and you don't have to maintain it in the same way," comments den Ouden.

Swap shop

In several recent projects, ELeather was chosen as a replacement for another material. One example is NS, which chose ELeather for new-build trains that entered service in December 2017. "This project was won against a faux leather," says den Ouden. "They chose a traditional leather grain finish in red for first class and in light blue for second class."

Another customer, NTV, chose ELeather over a traditional leather for trains that entered service in January 2018. The operator went with a combination of grays and reds with small inserts to differentiate the designs between the classes. "A key reason for NTV's decision to use ELeather was the advanced durability it offers compared to traditional leather, which often needed replacing in high-use passenger areas," says den Ouden.

Future focused

Beyond these in-service trains, ELeather also features extensively on Deutsche Bahn's Idea Train concept. "DB originally specified quite a high percentage of fabric upholstery for the concept, because they wanted a mix of textures and finishes," reveals den Ouden. "We explained that you could actually use different textures, all in ELeather, and achieve very different finishes, even if it's the same color. After presenting different design options, DB decided to introduce ELeather into additional zones on the concept train."

He heralds the Idea Train for pushing the boundaries of design and responding to an increased focus on the passenger experience, just as ELeather is trying to. "It is exciting for people to think you could get on a train and do your morning workout on a bike, or watch your children enjoying a play area and know that if they spill something, it's not the end of the world," says den Ouden. "This concept will push other people in the market to think about the same kind of things."

CUSTOM PROJECTS

An increased focus on design may lead to a greater demand to customize. ELeather can be customized through printing, stitching or embossing. In addition, a semi-perforated product is available.

"ELeather is highly receptive to a number of finishing techniques," notes Nico den Ouden.

"In general, there's been a slower adoption of customization options than in some other markets we operate in; however, there has been an increase in the rail market and this is something we are very happy to support," says Alexandra Bennett, strategic marketing manager at ELeather.

Solid base

Forbo explains how its floor coverings were chosen and customized for Virgin Trains East Coast and Hitachi Rail trains

Recent customers for Forbo Flooring Systems' portfolio of floor coverings include Virgin Trains East Coast and Hitachi Rail. In both cases, Forbo worked closely with the customer to meet their specific needs. The company provided Coral FR in the vestibules and Coral Move FR in the saloons for Hitachi Rail, and Coral FR in the vestibules with Tessera FR in the saloons for Virgin Trains East Coast. A textile flocked floor covering, Flotex FR, and a linoleum product, Marmoleum FR, round out Forbo's rail product portfolio.

Forbo is working closely with Hitachi Rail on numerous new-build rail vehicle projects in the UK, including Trans Pennine Express, Abellio Scot Rail, West of England and IEP Great Western Main Line/East Coast Main Line. All vehicles have Coral Classic FR in the vestibule areas, and the Abellio Scot Rail project also has Coral Move FR carpeting in the saloons.

The first contact with Hitachi was made via DCA Design International in 2010, regarding design concepts. The building and fit-out of these new rail vehicles has predominantly been managed via Hitachi's UK manufacturing facility in County Durham. The flooring installations began in 2016 and are ongoing.

A key part of the equation

Hitachi called on the services of DCA, a leading product design and development consultancy, operating globally from its headquarters in Warwick, UK, with transport being one of its focused market sectors. A senior associate of the company, Paul Rutter, explains that train interiors comprise a rich variety of materials, colors and finishes and that a key part of the interior mix is the carpet. Often overlooked as a visual component, the carpet serves as an important backdrop that sets the overall look

Standard class on Virgin Trains' East Coast service features Tessera Alignment FR

Customization and ease of cleaning were primary criteria for selecting the Move and Coral carpet products for Hitachi, plus the overall low cost of ownership

Paul Rutter, DCA Design

ABOVE: Hitachi Rail selected Forbo's Coral Move FR for the saloons on the Abellio Scot Rail project

and feel. Pattern, texture and underfoot feel convey a sensual quality that can lift a design.

"Forbo offers the degree of customization needed to create individual carpet designs from a standardized product range. This is cost-effective and provides the unique quality that rail operators are keen to offer," says Rutter.

"When designing the interiors of Hitachi's new intercity and commuter fleets, Forbo offered a choice of carpet types suitable for high-wear areas like vestibules and in the first class and standard class saloons, where a quiet, comfortable traveling environment are the key requirements."

Forbo carpets provide protection, sound attenuation and add that 'domestic touch'. Mass-transit vehicles like trains and metros often use hard floor coverings; Forbo's textile products are designed to provide similar levels of practical performance but add a degree of visual quality that enhances the journey.

"Customization and ease of cleaning were primary criteria for selecting the Coral Move FR carpet products for Hitachi, plus the overall low cost of ownership," continues Rutter. "By having a choice of bonded or replaceable (using hook-and-loop fastening strips) the carpet fitting process is cost-effective and efficient."

Virgin Trains East Coast

When Virgin Trains East Coast took over its franchise in 2015 it made the decision to refurbish and rebrand its fleet of trains. One of the particular challenges facing the operator was to select a flooring that was aesthetically appealing and compliant with all fire and safety standards, while being hard wearing and easy to clean. The customer found its solution in Forbo's wide range of flooring products. The project was completed in 18 months from initial design conception to installation.

On this design-led project, Virgin Trains East Coast used the skills of Charles Greenway and Graham Love from Atlantic Design, who approached Forbo in 2015. Greenway, Atlantic Design director, explains why Forbo was chosen over other companies in the market:

"Atlantic Design has worked with Forbo for many years," he says. "Their willingness to listen and respond to our requirements has resulted in some excellent solutions for our clients."

412 coaches refurbished

The project, which comprised two fleets of long-haul intercity vehicles, ran from June 2015 to January 2017 and the refurbishment took place at two depots – Edinburgh Craigentinny and London Bounds Green. Yellow Rail took care of floor installation for the work at Bounds Green and TXM projects did the same at Craigentinny. A total of 412 coaches underwent refurbishment, comprising 30 nine-car MKIV electric sets and 15 nine-car HST diesel trains, plus a number of spare vehicles.

For any rail interiors project, compliance with stringent safety standards and easy cleaning characteristics are mandatory. However, design also remains a crucial element if passenger satisfaction is to be achieved. That is why Virgin Trains East Coast chose floor coverings that would ensure visual appeal while satisfying passengers' desire for comfort – paramount on longer journeys.

"We used Forbo as its products had been used in other Stage Coach Group projects, for example East Midlands Trains, and we had heard good reports," comments Bryan Winslow, fleet materials and procurement manager at Virgin Trains East Coast. "Forbo could match our desired style and brand preferences."

Tessera Alignment FR is a tufted multi-height loop pile carpet manufactured from 100% solution-dyed nylon 6.6 yarns. It was chosen because its composition was created to make the carpet a cost-effective and convenient alternative to the wool-based flooring traditionally used in saloon car interiors.

"From a design and maintenance perspective the Tessera FR product is unique," says Greenway of Atlantic Design. "When reviewing floor covering products for the Virgin Trains East Coast refurbishment, we took our client along to review the Tessera FR we had specified on the East Midland HST fleet six years earlier. Its

RAIL PRODUCT PORTFOLIO

Coral Classic/Duo FR
By removing wet and dry soiling from the soles of shoes and wheel treads, an effective entrance system reduces premature wear and tear to interior floor coverings, minimizes cleaning and maintenance costs and protects passengers by reducing slip hazards.

Coral Move FR
A tufted carpet solution for rail interiors made from 100% regenerated Econyl yarn. Offering extensive customization possibilities to complement interior design and color schemes, Coral Move FR is a bespoke product and Forbo's dedicated design team will work to match design and color requirements on an individual project basis.

Tessera FR
A collection of hard-wearing carpets, offered in various pile constructions and textures, all designed to deliver specific aesthetic and performance advantages. Forbo contends the installation of carpet in rail vehicles yields warmth, comfort and acoustic benefits.

Flotex FR
This flocked floor covering is designed to combine the easy-cleaning properties and durability of a resilient flooring with the comfort, slip resistance and acoustic properties usually associated with textile floor coverings. The Flotex Vision range comes in more than 500 designs and colors and is digitally printed. Forbo offers a complete custom design service, enabling customers to match the floor precisely to their interior design scheme or corporate identity design/colors.

Marmoleum FR
As well as offering total versatility in terms of color and design, this floor covering is notable for being made from a high percentage of natural raw materials, with renewable and recycled content. All Marmoleum FR floors include Topshield, a double-layer, UV-cured finish formulated to be scratch- and scuff-resistant, easy to maintain and to ensure long-lasting appearance retention. This solution is particularly suitable for heavy-traffic applications.

ABOVE: Tessera Alignment FR in the first class section on Virgin Trains' East Coast service

The design and production team at Forbo worked patiently with us to develop the custom 'velocity' pattern with increased density along the aisle to hide wear

Charles Greenway, Atlantic Design

performance was exceptional, the original design being still vibrant and in excellent condition. We required something new for Virgin Trains East Coast and the design and production team at Forbo worked patiently with us to develop the custom 'velocity' pattern with increased density along the aisle to hide wear. It was not a difficult decision to select Coral Duo FR for the entrance areas due to its unique high performance and attractive appearance."

Moisture removal

With Coral Duo FR, passengers entering the vestibule are met underfoot by a moisture-removing surface that helps to remove wet and dry soiling from the soles of shoes and suitcases. It is also designed to help prevent premature wear and tear to interior floor coverings, which in turn minimizes cleaning and maintenance costs. It is engineered to protect passengers by reducing slip hazards, especially important given the rail industry's need to comply with Disability Discrimination Act requirements.

Forbo's products are tested to withstand high volumes of traffic, which is especially reassuring considering the dramatic increase in rail passenger numbers over recent years. With ridership predicted to continue to rise, flooring was chosen by Virgin Trains East Coast with longevity in mind.

"We have received no negative feedback and are extremely satisfied with the result," says Winslow. "We are particularly pleased with the way Forbo dealt with any initial issues and the performance of the floor coverings has proved a success."

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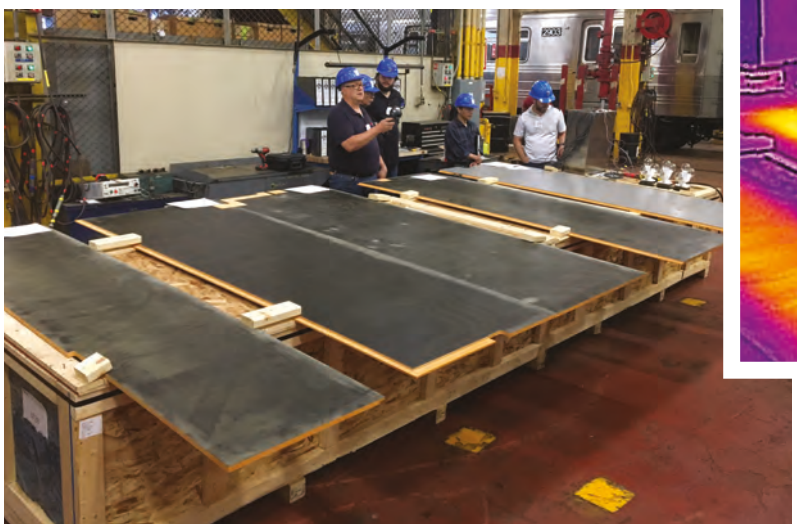
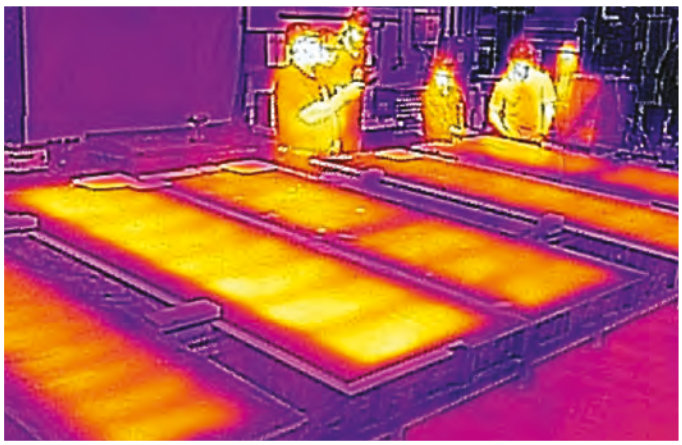




LEFT AND ABOVE: Bench testing of MCI's heated floor system operating off the third rail (600V DC)

Designed for life

20 years into service, a phenolic composite floor solution from Milwaukee Composites is still reaping benefits for SEPTA

During a 1997 meeting with rail transport equipment manufacturer Adtranz, Jeffrey Kober, president of Milwaukee Composites (MCI), learned of sub-floor issues the manufacturer was experiencing as a part of its Southeastern Pennsylvania Transit Authority (SEPTA) program in Philadelphia, USA. Over the course of the meeting, Kober took note of Adtranz's challenges, ranging from weight issues that SEPTA had with its fleet, to the recurring failure of plymetal floor panels. Kober returned to MCI and set out to solve SEPTA's problems, His determination was rooted in his extensive knowledge in materials science, which has seen him earn two US patents.

Kober researched numerous materials extensively. He ultimately identified a solution in a phenolic composite panel, which addressed SEPTA's weight concerns, provided superior fire safety and eliminated the recurring costs stemming from the floor panel replacements. Convincing SEPTA and consulting groups that a 'plastic' floor could survive in rough environments had its challenges. Sound engineering and extensive testing combined into a compelling argument that MCI's product was the perfect solution.

Customer feedback

"The new phenolic composite floor design resulted in a considerable weight saving and additional long-term benefits," says Jody Cox, the senior project designer SEPTA assigned to the program. "One of these benefits pertains to the longevity of the panels. With the phenolic composite materials being impervious to water, moisture-related failures are now non-existent. Also the material is not affected by fatigue, ensuring that the floor application has the potential to last the life of the vehicle.

"A safety benefit is that it acts as a fire block material during ASTM E119 flame from below testing. This test is considered very difficult, but this design passed easily, even at twice the time requirements. SEPTA has been extremely satisfied with the composite flooring to date and has plans to include it in future major overhauls and new fleet acquisitions.

"We feel our need for weight reduction had led us to a new technology that has not only resulted in weight savings but has also delivered a long-term application that will reduce future maintenance and increase fire safety, not only for SEPTA but for the rail industry in general."

The composite advantage

Since 1998 MCI has provided more than 14,000 floor sets that continue to run every day worldwide. Whether for trains or buses, MCI trusts in its patented manufacturing process to eliminate delamination and corrosion issues that have plagued the transit

industry. For MCI, it's a matter of understanding the materials and designing to their benefits.

Composites are well known for their impressive fatigue resistance. MCI has successfully fatigue tested its floor system to almost 100 years of simulated service life without degradation. Once car builders understand the capability of the materials, MCI finds that they are more open to investigating alternative designs and installation techniques, including bonding the floor system with adhesive, which MCI notes can save considerable time and money during the installation process. This fit-and-forget approach is the reason MCI has been a supplier to New York City Transit (NYCT) since 2007. MCI reports that NYCT and its consulting groups have been extremely satisfied with a floor system that continues to provide maintenance-free service while offering energy savings through weight reduction – on certain designs by over 800 lb (360kg) per car.

Heated floors

With Kober at the helm, MCI continues to be an engineering-focused company that challenges itself to be a pioneer in applications for phenolic composite panels. MCI has expanded its portfolio over the years to include heated floors, doors, vertical walls and ceilings.

The new phenolic composite floor design resulted in a considerable weight saving and additional long-term benefits

Jody Cox, formerly of SEPTA

ABOVE AND RIGHT: Phenolic composite doors in service

RIGHT: MCI installed the first phenolic composite floor system in 1998 for SEPTA, where it continues to exceed expectations

Recognizing that many car builders were striving for improved passenger comfort, MCI designed its patented heated floor system with carbon-fiber technology to provide uniform heating throughout a vehicle. Extensive research of a variety of heating element technologies was required before the ideal solution for a composite panel was found. MCI is convinced it makes sense to have a composite heating element for a phenolic composite panel.

MCI's heating system works with a dynamic temperature control unit to regulate the power provided to the floor panels to ensure a consistent, safe and controlled environment. MCI's system is designed to overcome thermal losses in a vehicle while providing the required heat capacity, as opposed to on/off systems that may never achieve their required temperature. Siemens Industry in Sacramento, California, was the first to use this floor system for Calgary Transit, where the floors have been running for over two years.

In addition to heated floors, MCI was also asked to design a solution for the many issues associated with metallic doors. MCI has gone through rigorous testing since 2013 in the USA as well as in the UK to create a solution that provides weight reduction along with the elimination of corrosion and delamination. MCI successfully passed all required tests and produced a phenolic composite door solution that is currently running in Chicago and New York in the USA, as well as in the UK.

Foundation for safety

The UK's IEP and Malaysia's KVMRT both required safe, reliable and customized flooring solutions

Treadmaster has been working as a key supplier to Hitachi Rail since the first InterCity Express project (IEP) Class 800/801 trains were commissioned in 2014. The new intercity trains are now nearing passenger service as part of the £5.7bn (US$7.6bn) investment to modernize journeys along the UK's East Coast and Great Western main lines. As part of the manufacturing process, there has been a strong focus on a high-quality, UK-based supply chain offering bespoke solutions.

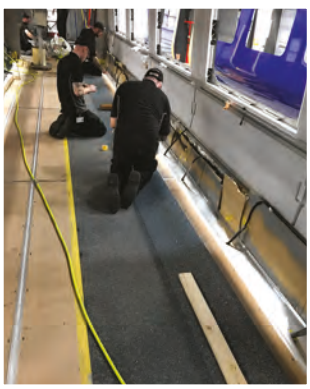
Hitachi's engineers were looking for a flooring product that could provide a dual solution in the passenger cars. The aim was firstly to support the primary floor covering of carpet and help it to achieve the stringent fire standard of BS6853 Cat1b, and secondly to provide a water-resistant barrier between the carpet and the subfloor to protect the subfloor from liquid ingress and potential costly maintenance.

The IEP also presented challenges for the interior design team at DCA, especially in the key areas of toilets and driving cabs. As with all new train designs there is the difficult task of selecting materials that have the right mix of visual integrity, longevity in service and technical performance.

From a design perspective it is important to select materials that offer the right balance of physical attributes – easy to clean, hard wearing, slip resistant surfaces with a premium look and feel to give the right visual impression.

"All too often materials can be selected on price (to meet low budget requirements) or on purely physical performance (fire resistance and abrasion properties)," says Paul Rutter, senior associate at DCA. "In isolation these features meet the technical specification but do not create that special quality that the best designs can achieve."

TM7 flooring helps KVMRT in Malaysia to meet the BS6853 Cat1a fire standard



ABOVE: Treadmaster developed a custom water barrier solution for the IEP

Bespoke for Hitachi

Using existing technologies, Treadmaster developed a bespoke flooring solution that could be used as a water barrier while meeting the fire requirements of BS6853 Cat1b. The product is 1.5mm (0.06in) thick, half the thickness of the company's standard rail flooring products.

In the case of the IEP toilets and cab design, Treadmaster technical flooring TM8 was selected to provide the right combination of design flexibility and to outperform the technical requirements. "The ability to select colors that integrate with the interior schedule of finishes was a big bonus as it allowed the customization of the designs rather than the use of standard catalog colors and finishes," comments Rutter.

Treadmaster has a proven pedigree in providing the highest fire retardant flooring for the rail sector and particularly for underground rolling stock. It is the current flooring supplier to London Underground and is working on a number of projects for Transport for London, including the new Elizabeth Line trains.

"Although we specialize in metro and commuter rail applications, the Class 800/801 programs demonstrate that we have the flexibility and engineering capability to work on bespoke products for our customers," says Simon Andrews, Treadmaster's business development manager. "We can offer solutions for all types of rolling stock and although fire safety is a higher priority when considering which flooring to specify on rolling stock, other attributes such as wear and slip resistance, design aesthetics, cleanability and maintainability are also key factors."

Treadmaster is continuing to support Hitachi on its other contracts, including Class 385 trains for Abellio Scotrail and the West of England Class 800/801 rolling stock programs for GWR.

RIGHT AND FAR RIGHT: TM8 fulfills Hitachi's performance and design requirements for high-use areas on the UK's IEP

The ability to select colors that integrate with the interior schedule of finishes was a big bonus

Paul Rutter, DCA

HOT TOPIC

In rail, fire standards are much more stringent than for buildings, but the fundamental principle should always be the same – safety should never be compromised over cost.

As of 2018, the New European Rail Fire standard EN45545-2 is mandatory across Europe and is set to take over from existing national standards such as BS6853. The key focus of this is to harmonize rail fire standards across Europe, making it easier for European companies to have access to the wider European market without having to meet all the previous existing national fire standards.

"In some quarters the new EN45545-2 standard is acknowledged as being less stringent than the existing national standards, and as a consequence some materials that didn't meet those standards may now meet the new European standard," says Simon Andrews of Treadmaster. "Specifiers and operators should not feel pressured to reduce costs by using materials that would not have previously met the national standard but now meet the European standard."

Treadmaster can offer robust rail compliant floor coverings, as its TM7 flooring meets BS6853 Cat1a and EN45545-2 HL3, and TM8 meets BS6853 Cat1b and EN45545-2 HL3.

Another important implementation for Treadmaster is the Klang Valley Mass Rapid Transit (KVMRT) System – one of the most important and largest transport infrastructure projects Malaysia has embarked on. This project will provide a major boost to the integration and efficiency of urban public transportation.

In October 2012 the consortium SSSC (Siemens Malaysia, Siemens and SMH Rail) was awarded the contract to supply 58 driverless four-car metro trains. The trains are capable of carrying up to 1,554 passengers (at eight persons per square meter), with 174 seats and standing room for 1,380 passengers. The train is designed for operation in tunnels and on elevated tracks.

The vehicles are part of the Inspiro family. The car bodies were produced by CSR Puzhen in China, with the final vehicle assembly conducted in Malaysia by SMH Rail.

Modern Malaysia

Designworks, a BMW Group Company, developed the interior and exterior design. The guiding design concept was inspired by the architectural characteristics of modern Malaysia and reflects the dynamism, elegance and technological progress of Kuala Lumpur.

For the flooring design, Treadmaster and Designworks USA joined forces. Together the partners developed a holistic interior that combines future thinking, customized processes and in-depth expertise in the rail industry.

"Treadmaster was a valuable partner to create a solution that stayed true to the initial design intent," says Elke Weisbarth, color and material designer at BMW Group Designworks USA. "With a high degree of design understanding, profound knowledge of how to move things in bigger structures, and with innovative solutions for solid colored floor coverings that fulfill the highest demands in the market, Treadmaster helped us implement a holistic design approach from the big picture to small details. The result is a comfortable interior perception of well-being."

Treadmaster supplied two gray colors of its highest fire retardant flooring product, TM7, so that the trains meet fire protection requirements according to BS6853 Cat1a.

RIGHT: The universally accessible version of Samo II

The modularity of Satek's Samo II toilet was beneficial in creating two practical and on-brand versions for Südostbahn's Pre-Alpine Express

The chameleon

In *Railway Interiors International Annual Showcase 2017*, Satek proudly presented the latest generation of its modular sanitary cabins. Since then the company has seen some exciting months. The latest version of the Samo II has been developed to combine practicality, lightness, flexibility, design and sustainability perfectly.

For several months, Satek and Stadler have been working together on the realization of sanitary modules for the new Traverso train, Flirt. This highly specialized low-floor train will be used as a Pre-Alpine Express by the Südostbahn (Swiss South Eastern Railway) beginning in 2019. It will run on hourly journeys on the beautiful route from Lucerne via Arth-Goldau, Pfäffikon and Rapperswil to St Gallen. Besides maximum comfort and a great interior design, attention has been paid to low energy consumption and high load capacity.

Two versions

Satek is also faced with these requirements with its sanitary modules. It has developed two versions of Samo II for the Pre-Alpine Express. Each train will be equipped with a universally accessible module that complies with TSI PRM requirements, and two smaller and lighter standard modules.

The modularity of Satek's sanitary cabins has proved to be a successful concept – though this project took a bit longer, normally customized versions can be developed in three to eight months.

ABOVE AND LEFT: Satek also took care of the fresh water and sewage systems to support Samo II on the Pre-Alpine Express

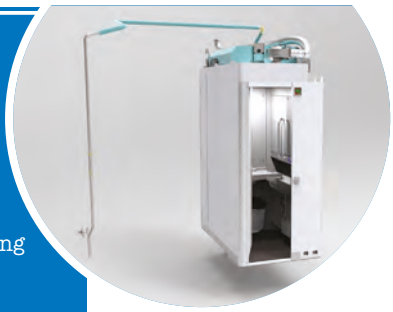
MODULAR CONSTRUCTION

With Samo II, customers can assemble their own configuration of modules, or choose from module kits that have been preconfigured for specific functions. Additional functions can be added through independent functional modules, for example including a baby-changing table. These can be integrated on the inner walls of the cabin.

Satek also had ease of integration in mind when developing the closing systems for inspection doors and flaps. They are designed to enable easy replacement at a later date.

Various locking systems are available – this flexibility is enabled by a clever adapter system. "The advantage of this is the cross-model use of identical parts, like in the automotive industry," says Karl Felsing, head of engineering at Satek.

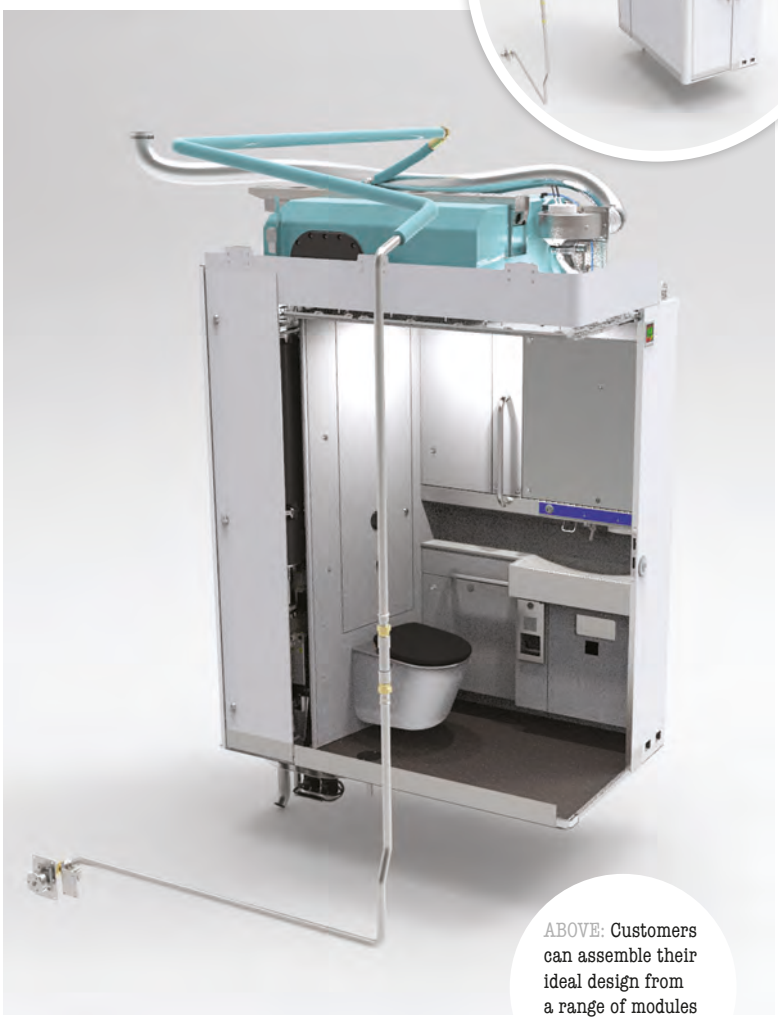
Since the introduction of Samo II, Satek has been able to use the same parts for four types of rail vehicle. "This has been a strategic success," says Felsing. "Stock keeping and procurement costs can be permanently reduced, and not only can higher efficiency be achieved in the engineering sector, but also more capacity can be created. This in turn leads to greater flexibility in the processing of various rail vehicle projects and models."



ABOVE AND BELOW: The standard version of Samo II will also be installed on the Pre-Alpine Express train

Nothing is worse for train operations than complaints that require them to constantly buy spare parts and have the trains out of service

Jürgen Kaiser, Satek



ABOVE: Customers can assemble their ideal design from a range of modules

The company has also had consistently positive feedback from customers and operators regarding the module's clear lines and functional design. Likewise, service teams, who have to maintain the vehicles and therefore also the sanitary modules for up to 30 years, have praised the accessibility of serviceable parts.

In service

The flexibility of Samo II also extends to its in-service life. Colors, decor, floor coverings and walls can be changed simply and quickly, saving the operator time and money. The system is also optimized for maintenance and continuous improvement.

"The higher the quality, the more sustainable and durable our sanitary modules," says Jürgen Kaiser, general manager at Satek. "Nothing is worse for train operators than complaints that require them to constantly buy spare parts and have the trains out of service for replacements to be made, costing them time and money. For this reason, ensuring easy maintenance is always a key focus of our developments."

High quality and innovation characterize the Traverso down to the last detail. The same is true with the toilets. For Satek, a unique feature of this project was the need to integrate a bioreactor for wastewater treatment, even for the standard modules, which could be implemented in the same small space as a simple wastewater tank system used by a standard module.

For the Pre-Alpine Express, Satek also supplied the complete infrastructure to support the sanitary modules, from fresh water and sewage systems through to the physical connections to the vehicle, and Ethernet communication and signaling technology.

Inner peace

Polyurethane can be used in railcar constructions to reduce noise and vibrations, leading to a more pleasant experience for passengers

Rail companies are looking to win customers with fast, reliable and comfortable connections. Noise and vibrations can be reduced by bearing the car floors and HVAC units on high-tech elastomers made from polyurethane (PU). As well as encouraging more passengers to opt for rail travel, vibration protection means interior fittings are not subjected to the same extreme loads and the service life of the floor is extended. The result is longer maintenance intervals for the railcar.

Elastic materials from Getzner Werkstoffe have been used in rail superstructures for more than 40 years. For the past 20 years, these materials have also been deployed in the construction of rolling stock. The PU products have been established under the names Sylomer, Sylodyn and Sylodamp. They are made without softeners or halogenated foaming agents. “The materials are ideally suited for use as vibration isolation solutions; long-term studies by third parties show that neither the dynamic behavior nor the elasticity of the material decrease over time,” says Thomas Gamsjäger, senior vice president of the Industry division at Getzner. “Unlike rubber, PU products do not become stiff or brittle. The material’s good recovery and low creep behavior is guaranteed for the car’s service life. There is no settling, which can cause the construction height to drop or cracks to form, or moisture ingress.”

Noise reduction

Vibrations are also effectively isolated using the PU materials. Gamsjäger says a decrease of 4dB of secondary airborne noise in the car is realistic. “PU materials also have clear benefits when it comes to the internal structure of the car,” he continues. “They allow both the height and the weight of the floor construction to be reduced. Moreover, the Sylomer linear supports or discrete bearings attached directly under the floor panels compensate for any unevenness in the body shell, meaning there is no need for the costly and time-consuming installation of compensation elements.”

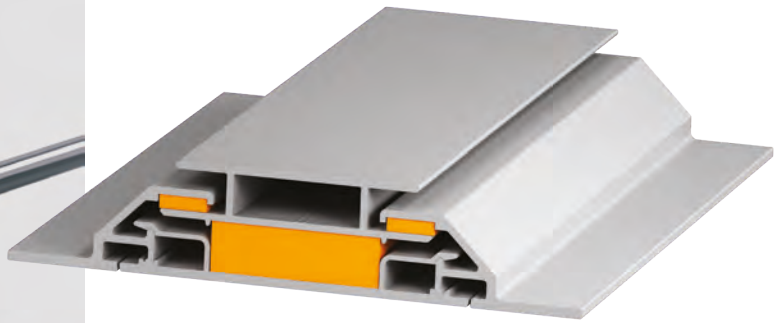
ABOVE:
The efficient bearing of the car floor and HVAC units reduces noise

BELOW:
Vibration protection creates a more peaceful environment for passengers

External tests

Tests were carried out by external laboratories in Finland and Spain to examine the efficiency of a floating floor with Sylomer and Sylodyn strips. Due to the lack of binding regulations for testing elastic floor components under different load conditions, various standards (such as DIN EN ISO 3381:2011, TSI NOISE (EU), 1304/2014 and DIN 45635) were consulted and general common requirements related to vibrations and noise levels were observed.

The tests conducted in Spain were mostly aimed at determining the dynamic performance of various floor systems. This meant comparing discrete bearings and linear supports made from Sylomer as well as a phenolic resin floor panel and a rubber element. “The results show that Sylomer is much more efficient in all load situations, due to its non-linear elastic behavior,” says Gamsjäger.



ABOVE: Using Sylomer and aluminum for floating floors reduces vibrations and ensures the lowest weight

BELOW: Sylomer strips integrated in a floating floor

CUSTOMER SERVICE

At Getzner, specialists work hard to meet individual customer requirements. Along with the development of solutions for specific applications, these experts also support customers during the calculation and simulation stages. They provide efficacy forecasts and proofs and carry out vibration measurements, as well as material tests and measurements on the company's large-scale test rig.

Getzner can also observe customer-specific requirements during the manufacturing process. Along with continuously poured PU mats, different molded parts and made-to-measure materials are available. PU can also be combined with other materials if necessary.

Long-term studies by third parties show that neither the dynamic behavior nor the elasticity of the material decrease over time

Thomas Gamsjäger, Getzner Werkstoffe

It is important to save weight in car construction. Combining aluminum with PU materials for floating floors in rolling stock has proven to be an effective tool here. For this reason, Getzner Werkstoffe worked with Hydro Aluminium to develop the Sylomer Aluminium Vibration Damper with a total weight of 3kg/m (1.98 lb/ft). "The combination made from Sylomer and aluminum has a high load capacity and ensures efficient vibration decoupling," comments Gamsjäger. "Furthermore, its installation could not be easier: the aluminum damper is fixed directly to the floor with screws. It also complies with the relevant fire prevention and crash safety regulations."

Decoupling with Isotop

Air-handling units and other large units that are attached to the car body or roof cause vibrations and noise in the passenger areas. Spring and damper combinations, such as the Isotop DZE Railway, which has the PU materials Sylomer, Sylodyn or Sylodamp in its stainless-steel core, have proven effective in tackling this. They are designed to reduce the spread of structure-borne noise and vibrations. "For the bearing of HVAC units, we can guarantee an insulating effect up to 12dB higher than that offered by rubber-metal products," says Gamsjäger.

The spring and damper combination can be tailored to the area of application. Vibrations at loads between 50-1,000kg are thus sustainably reduced. Isotop DZE Railway also has a high load capacity whether under compression or tension, accommodating brief loads of up to 5*g*. It is certified for use in the rail sector in accordance with DIN EN/IEC 61373.

Fire protection

Demand for vibration protection solutions is growing. The same applies for fire-retardant materials – particularly in relation to increasingly strict global fire prevention requirements. According to the European standard for rail vehicles – DIN EN 45545-2 – the products used must comply with the highest possible classification of Hazard Level 3 (HL 3). Depending on the country, the American NFPA 130, British BS 6853 or Japanese JRMA may need to be complied with. PU products such as Sylomer Fire-retardant – which is produced without halogenated fire protection agents or toxic substances – conform to these specifications and are RoHS compliant, so are therefore suitable for use in rail vehicles.

Transport of delight

Thermoplastics can support inspired designs – which are vital to help the rail market compete in an evolving transportation landscape

As trains enters a new era of popularity, thermoplastic design can make rail travel even more attractive, believes Rich Cort, mass transit market business manager at Sekisui Polymer Innovations (SPI).

"These days, rail lines are competing with airlines," Cort explains. "This trend is moving especially fast in Europe and Asia as high-speed trains overtake aircraft in both travel time and comfort. Passengers are considering ticket prices, time spent getting to and from airports and flight delays – and opting to stay on the ground. The sheer luxury of high-speed rail, with comfortable seating, onboard wi-fi and other high-end amenities, makes traveling by train more of a pleasure, especially in business class. It's no surprise that ridership is up worldwide."

Tourism by rail is also a popular option. The Rocky Mountaineer, a tourist train that travels through the breathtaking landscapes of Western Canada, is a perfect example. "People aren't just signing on for the scenery and the food," says Cort. "They also want a luxurious interior experience."

ABOVE: Some examples of the possibilities offered by infused imaging

Implications for train design

For Cort, it's more important than ever to seek out materials like thermoplastics that can bring bold design ideas to life. "Now is the perfect time for designers to learn what is possible and how to design for it," he says. "Builders and transit authorities can set their sights higher and demand more to stay competitive."

With global travel on the rise, so are travelers' expectations. Cort believes that basing a design choice on cost alone can result in disappointment for passengers. "Train interior designs can also provide refined aesthetics, providing as pleasant an experience as travelers get in aircraft interiors," he says.

SPI is meeting this challenge by thinking like designers. The company has a decades-long history of creating thermoplastic sheet

ABOVE: SPI thermoplastic is used in Qatar Airways' Qsuite business cabin

Creating a visual impact is what we thrive on; plastic is only the medium

Rich Cort, Sekisui Polymer Innovations

and has now moved beyond manufacturing with a commitment to aesthetics and innovation. It has expanded its designLab, a collaborative workspace where designers and customers team up to develop an even deeper understanding of color and design.

Design thinking is also reflected in pioneering techniques that push design to higher levels. Infused Imaging is a proprietary, pattern-in-product technology that enables bespoke design and branding opportunities. Bonded build-up is a new way to combine plastic with materials such as leather and carbon fiber for beauty as well as strength.

Thermoplastics design house

The company is evolving and making thermoplastic sheet is only part of SPI's story. "Creating a visual impact is what we thrive on; plastic is only the medium," explains Cort. "We're actually a design house that creates things with our focus on exploration and ideation."

According to Cort, thermoplastics offer what other materials can't. "Everything else has limitations," he says. "Fiberglass comes in solid colors only, metal can only be painted, and high-pressure laminates can be decorated but not shaped. Thermoplastics, however, deliver it all – color, shape, texture and decoration. Perhaps that's why it is the material of choice in many airline applications." SPI sees equal potential for the rail market.

New vision

To help build awareness of thermoplastic's possibilities, Karyn McAlphin has joined SPI as design strategist. With 25 years of airline experience and a focus on interiors, McAlphin has helped develop award-winning aircraft designs. Now she's setting her sights and design know-how on mass transit.

Her role is to educate designers, builders and marketers about the capabilities of thermoplastics. With her support, designers can envision new possibilities for how a railcar can look and how passengers can feel. "Everyone at SPI shares a common goal of being not just a supplier, but a collaborative partner developing innovative solutions," says McAlphin.

Potential for rail

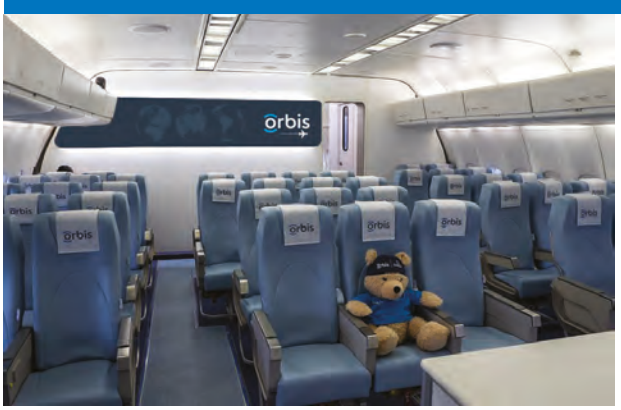
The United Airlines Polaris program is an example of thermoplastic's design potential – a success story that SPI believes can easily translate to rail. Infused Imaging components were used in United's redesigned business class suite, including privacy pods. The airline's new look was carried throughout the cabin using a frosted matte finish with a pearlescent glow. This distinctive Polaris design projects a feeling of luxury, helping to elevate the brand.

Taking a cue from the airline's success, SPI sees a possibility for rail operators to reimagine their look and brand by using advanced thermoplastic capabilities. It believes design-led thinking can transform and update train cars, elevating their image and growing ridership.

SEE THE DIFFERENCE

The Flying Eye Hospital is an in-air teaching facility with an operating room, classroom, recovery room and passenger seating areas. The interior of the aircraft, which was originally a cargo carrier, has been transformed with a clean new look. SPI manufactured the thermoplastic sheet for the bulkhead and used Infused Imaging technology to create an eye-catching element that showcases the Orbis International logo.

This idea can have an equally important place in train interiors, believes SPI. Rail lines could benefit from advanced designs and functions by using thermoplastic elements.



LEFT: A clean new look from SPI transformed The Flying Eye Hospital and helped showcase the Orbis logo

Traveling in style

What is a good rail journey? What do passengers want and expect?

With the ever-increasing demand on rail networks and operators striving to design trains that offer more for passengers, suppliers are being put to the test and asked to up their game in what they can provide to the rail sector.

It all comes down to what defines a good train journey, and creating the optimum passenger experience for travelers, commuters and those who aren't regular passengers. "The contributing factors include efficiency and reliability, customer service, cost, safety, the interior look and feel, as well as the comfort of the train," says James Newton, director of transport sales at Camira. "These all need to be considered as they can impact the first and lasting impression of a passenger's experience of any journey."

As a global textile manufacturer, Camira's priority is to create an interior fit for purpose with design, comfort and performance in mind. Camira designs and manufactures fabrics for seating, piping and headrests, curtains and wall sides, bringing interiors to life with a range of capabilities to suit any requirement and specification.

The company's in-house design team understands the capabilities of textiles for rail interiors and the importance of aesthetic appeal, whether distinctive surface effects are achieved through color, design, pattern or the weaving construction. "Fabrics can define the overall design and presentation of the interior, and durability and performance must be built in at the design stage," says Newton.

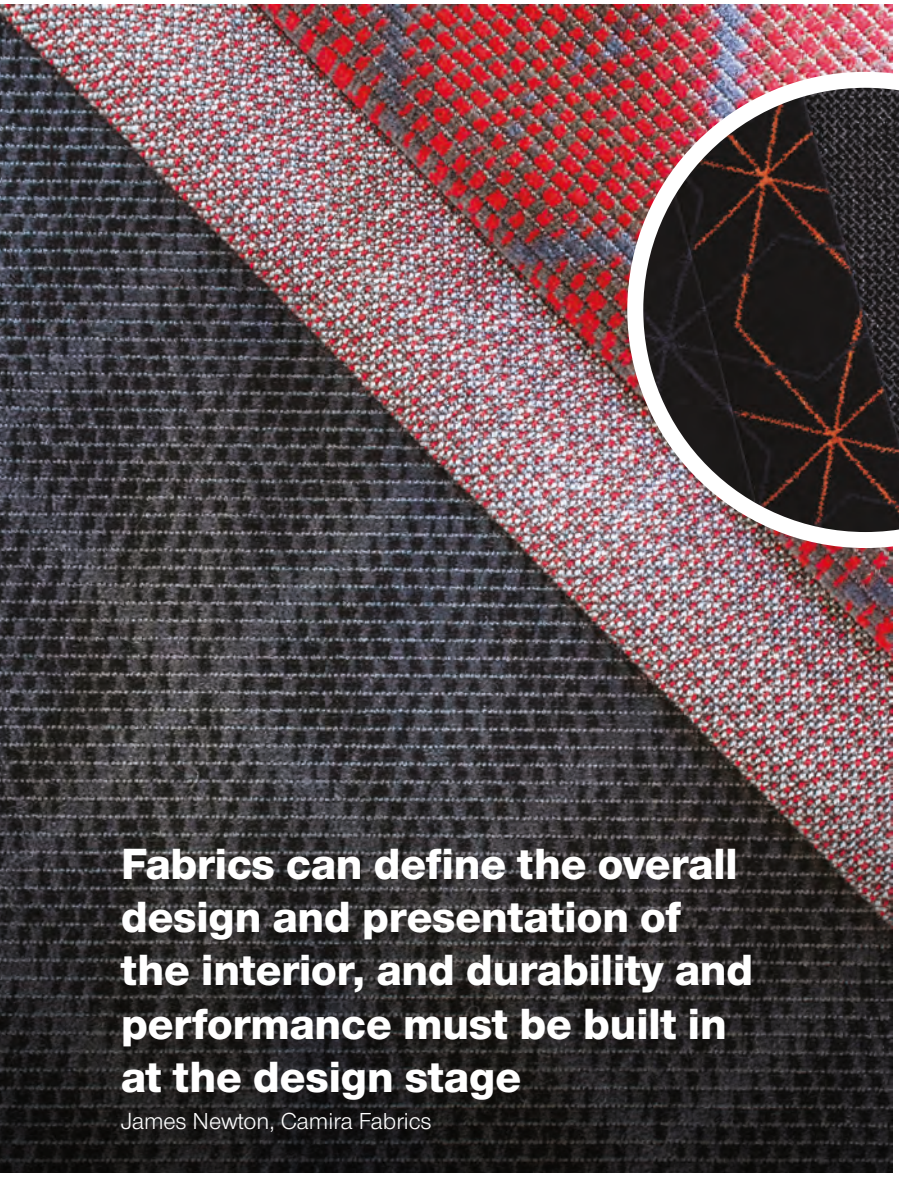
Working in close partnership with professional design houses and operators, Camira's designers and technical team create specific fabric solutions. The designers use their weaving expertise and manufacturing skills to interpret design briefs into what is possible in textiles, reflecting each brand's identity, developing new designs and colors to elevate the design of an interior and meet the necessary standards. As Newton says, "This allows manufacturers, designers and operators to push the boundaries of the future of rail travel."

Deutsche Bahn's Idea Train

Deutsche Bahn launched its Idea Train (Ideenzug) in 2017 to showcase new concepts and scenarios of how travel could change in the next few years. Working with several partners to create it, Deutsche Bahn selected a range of Camira's fabrics to feature

ABOVE: Fabric for London's new Elizabeth Line was woven on wire looms

RIGHT: A wide range of Camira's fabrics were used throughout Deutsche Bahn's Idea Train



Fabrics can define the overall design and presentation of the interior, and durability and performance must be built in at the design stage

James Newton, Camira Fabrics

LEFT: Camira's Wired fabric, which is made to order

INSET: Part of the Aura Twist range

throughout the train, including traditional mass passenger transport fabrics as well as a wide selection of innovative alternative fabrics normally used in the wider commercial contract market such as in public spaces, airports and office areas.

Considering aesthetic design, functionality and performance, the entire concept of the train was to inspire customers. The aim was to bring differentiation and new ideas to public transport with tangible concepts, from digital applications to the overall interior travel experience.

An interesting selection of fabrics was used throughout the Idea Train, including wool flat-woven fabrics, all-loop moquette, high-performance Trevira CS fabric, vinyl and leather, alongside a selection of flat-woven fabrics more commonly used for commercial interiors, made from wool, recycled polyester and natural plant fibers, engineered by Camira.

Fabrics made to last

Camira's fabrics are also, once again, being put to use by Transport for London. Camira has made fabrics for the operator for more than 150 years, ever since London Underground began. Custom-made moquette fabrics are used across the underground and on several overground train routes throughout London and are part of the well-known Transport for London brand.

One of the most recent developments is for Crossrail and the Elizabeth Line, named in honor of the Queen, which is the new high-speed railway set to transform travel across London. Running for more than 60 miles, the new line promises to cut most journey times by at least half and bring an extra 1.5 million people within 45 minutes of central London. The £14.8bn (US$19.7bn) project, one of the biggest infrastructure projects in Europe, sees the addition of 10 stations to the network and major upgrades to another 30 to cope with the extra passenger demand.

The new line, operated by Transport for London, is being opened in phases and will be fully operational by December 2019. It will feature 70 new 200m (656ft) trains, built in the UK by Bombardier in Derby, each able to carry 1,500 people in modern, air-conditioned interconnected walk-through cars, with CCTV, real-time travel information, wi-fi and 4G. In keeping with the royal name of the line, regal purple is the dominant color on Elizabeth Line branding, which is carried right through to the new fabric design from British design studio Wallace Sewell. The fabric is woven by Camira on wire looms to create a moquette with both cut- and loop-textured pile.

Catering for change

A recent collaboration with TransPennine Express for an onboard catering area showcases Birley's turnkey design, manufacturing and installation expertise

The recent TransPennine Express Class 185 refurbishment project demonstrates the turnkey service customers can expect from Birley. Working in partnership with Siemens in the UK, Birley was tasked with the design, manufacture and installation of a catering area for the trains.

The objective was to develop the first class carriage's existing catering area into a chilled food catering facility, within the same footprint. The new area was to include a chiller cabinet for pre-chilled products, an Atlas cart cupboard to store retail products, a spare urn cupboard, a workspace to prepare drinks and snacks, charging facilities for mobile devices and EPOS equipment, a shelving facility for product storage, and a trolley park.

Birley made a visual appraisal of the vehicle before producing concepts for Siemens to review. Throughout the detailed design stage, 3D models were produced in Solid Edge, with particular focus given to the bespoke designed chiller unit. In-house finite element analysis was then carried out, before manufacturing and installation drawings were produced. Before production roll-out, a prototype of the catering unit was produced for evaluation, trial fit and sign-off by the client.

ABOVE: The catering area produced for the TransPennine Express Class 185 refurbishment program

Focus on design

The successful evolution of the design was a credit to Birley's design engineers, who collaborated with stakeholders at all stages of the project. One of many clever design solutions that Birley implemented is the stainless-steel shelving for the chiller, which incorporates specially designed slots to optimize airflow within the confined space of the unit.

Within the same space as the old catering storage area, there was a need for extra storage. Birley's solution was to change the orientation of the trolley by 90°, creating space for a spare urn, Atlas chilled food trolley and additional storage space for commercial products. This also allowed space for the new trolley to be secured between the unit and a supporting frame, which features secure restraints to prevent the trolley moving. TransPennine Express wanted a design that would accommodate both the slightly narrower

existing trolley and the new trolley, pending the phasing out of the older design. Birley devised a bump stopper to retain the existing trolley, which could be removed easily from the unit during planned maintenance. With Siemens carriages having slightly different fixing points, a key feature of the unit is an adjustable back bracket, designed to allow for any intolerances and enable easy installation.

Interior products

At Birley's manufacturing facilities in Sheffield, UK, a wide portfolio of rail-compliant train interior products are designed and manufactured for both new-build and refurbishment projects. The company's core product range includes toilet modules, sleeper berths, catering galleys and a full range of interior trim solutions including center ceiling modules, tables, doors, vestibule panels, floors, draught screens and heater grilles, to name a few. With more than 20 years' experience supplying blue-chip retailers, Birley is able to supply railway stations with DDA-compliant ticket counters, full lounge refurbishments and customer welcome units.

LEFT: Birley's UAT module on the refurbished Class 144 diesel multiple unit

GWR Night Riviera Sleeper

In 2015, Birley won the contract to design and supply sleeper berths, the cocktail bar, catering galley and shop for the Night Riviera Sleeper train, operated by Great Western Railway (GWR) in the UK. The berth comprises aluminum-laminated panels, Dricon plywood berth doors with an electronic lock, aluminum honeycomb bunks, ceiling panels with LED lighting, a wardrobe and GRPh solid-surface vanity unit, windows with blinds, and a decorative shelf.

The new UAT demonstrates how Birley can turn a design concept into a high-quality, reliable product that reduces overall maintenance for train operators

James Taylor, Birley Manufacturing

Universally Accessible Toilet

Another of Birley's recent successes is its Universally Accessible Toilet (UAT) module. The UAT has been designed to provide high structural integrity in a two-piece modular construction that is fully compliant with PRM-TSI 2014 requirements.

"By 2020, all rolling-stock companies in the UK are required to provide long-lasting UATs in their train carriages," comments James Taylor, rail business development manager at the company. "Birley's extensive in-house knowledge of the rail industry – along with its stringent safety requirements, materials, operating procedures, testing and rail group standards – are helping clients to meet these needs."

One of the key benefits of the Birley UAT module is the sealed one-piece floor molding, designed to prevent the egress of liquids to the vehicle floor structure. The striking interior of the toilet is intended to provide the user with a spacious, hygienic environment, while retaining a contemporary modern feel. Industry renowned, proven and reliable equipment has been selected for the module.

Award recognition

In 2015, the UAT was highly commended by the UK's Manufacturers Association (EEF) in its Smart Product Award category. "The new UAT demonstrates how Birley can turn a design concept into a high-quality, reliable product that reduces overall maintenance for train operators," says Taylor.

The company's first UAT module has been in service for over two years with Porterbrook Leasing, on a refurbished Class 144 diesel multiple unit. Birley credits the unit's high quality and reliability with helping to lead to a recent contract by Wabtec Faiveley UK to supply 36 UAT modules for HST class trains.

ABOVE: Luggage stacks on ScotRail Class 158 trains, supplied by Birley

LEFT: The fitment of UATs will enable operators to meet 2020 legislation

Personal touch

To compete with future methods of transportation, railway operators must put the human experience at the center of their efforts and take ideas from other industries, advises Boxmark

ABOVE: Foam geometry is used to ensure body weight is evenly distributed across the entire seating surface

RIGHT: The colors, shapes and textures of materials can contribute to the well-being of passengers

When asking people traveling by train – no matter whether they are commuting to work or for pleasure – the advantages of their chosen transportation, the answer is often that travel time can be efficiently used on the train, especially compared with driving by car. As pleasing as this feedback seems to be at first, caution and farsightedness are necessary, as the mobility market is becoming more dynamic and complex.

The largest complexity driver is digitization. It offers new, innovative mobility platforms the opportunity to penetrate the market with strength. Another change will restructure the mobility market in the upcoming years: autonomous driving will offer passengers mobility on demand as well as productive use of their travel time.

Universal requirements

These developments pose challenges for railway operators if they want to maintain a leading role in the mobility market. When questioned about possible solutions, the industry agrees: in all considerations, the passenger's experience is the top priority.

It is also a good idea to think outside the box and take a look at other areas of mobility. "We support our partners in the railway industry, and are recognized partners to automotive and aircraft manufacturers," says Christian Schober, key account manager at Austrian leather manufacturer Boxmark.

THE HAPTIC EFFECT

Haptic properties unconsciously influence perceived quality. The power of the haptic effect unfolds everywhere, no matter whether it is in the living room, in the car or in a railway compartment.

"Leather is said to have a particularly strong and positive effect in this respect," says Thorsten Buhl, head designer at Boxmark. "How this effect is created, cannot be said for sure, but there is no doubt that there is obviously a close relationship between humans and the material, which is psychologically deeply rooted. This evolved, highly emotional relationship cannot be achieved with imitations. There is no true alternative for real leather in this respect."

ABOVE: Popular in interior design because of its texture, natural leather stimulates our senses of smell and sight

BELOW: Better air circulation improves seat comfort and good, more resilient padding can help prolong seat lives

Products need to pass the feeling test, because we can mishear and oversee, but there is no misinterpreting feeling

Thorsten Buhl, Boxmark

Schober explains his company has developed a product with partners such as Vanema, Airbus and Stelia Aerospace – Octaspring Technology, a seating foam material designed to be a third lighter than traditional paddings and with a foam geometry that distributes body weight evenly across the entire seating surface. The material won a Crystal Cabin Award in 2017 – one of the most sought-after innovation prizes in the aircraft industry.

Better air circulation improves seat comfort. The paddings are also engineered to be more resilient, prolonging their lives. "Our task was to adjust the padding and the leather trim to the special requirements of the aircraft industry," says Schober. "With the know-how and experience gained during this project we are certainly an interesting partner for the railway industry."

Human-centered approach

However, Boxmark is not only a leather manufacturer and processor. With 8,200 employees at nine sites worldwide, the company can take care of everything from research and development to production of the leather and completion of the finished product – all from one source.

The internal design department plays a particularly important role in the overall process. The company believes a human-centered approach will become more important in railway design. "Over decades of cooperation with automotive customers we have acquired extensive experience of which requirements must be considered in the process of designing vehicle interiors," says Thorsten Buhl, head designer at Boxmark. "With this know-how, we can offer valuable inputs for the railway industry."

The feeling test

Colors, shapes and especially the feel of materials can contribute to the well-being of people in their surroundings. Anyone who has visited a furniture store will have seen customers run their hands over a leather couch. "Products need to pass the feeling test, because we can mishear and oversee, but there is no misinterpreting feeling," says Buhl.

The skin is the largest sensory organ, and the sense of touch is of great importance. Touch and haptic sensations are important even in our early stages of development; toddlers touch the world in the full sense of the word. What does an object feel like? Is it hard or flexible, heavy or light, huge or small? What can be done with it? Every touch is linked to specific emotions and connotations: for example, warm and soft feels safe and harmonic, while cold and rough feels unwelcoming and uncomfortable.

With surface texture influencing perceived quality to this degree, it is no wonder that natural leather is so popular in interior design. Leather also stimulates our senses of smell and sight. "This multisensory address ignites a firework of emotions in the brain, forms product preferences and supports purchasing decisions," says Buhl, referring to studies from perceptual research.

Roller blind systems must offer quiet operation and full height adjustability

Made to measure

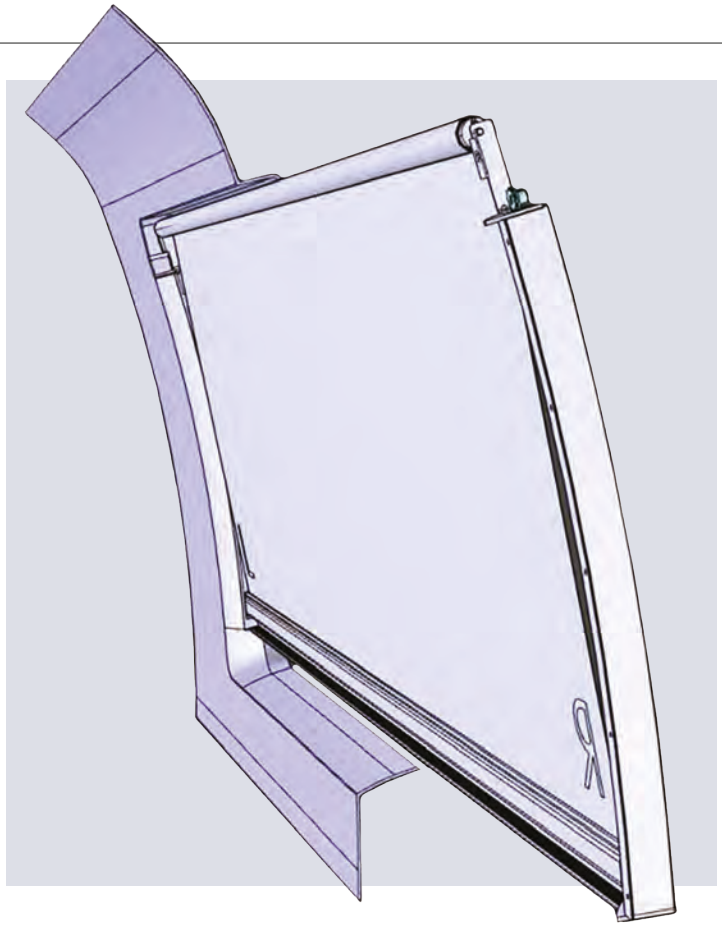
As design requirements become more complex, train operators will benefit from a partner offering flexible service and customization capabilities

Founded in 1990 in Zurich, Switzerland, Texat decor engineering (Tde) offers customized solutions and individual creations, with capabilities including fast prototyping and serial production. A small team works to provide high-quality interior equipment for customers, and bear in mind the needs of passengers and public transport staff.

Tde specializes in shading systems for driver cabs and passenger compartments. The company also supplies products such as floor coverings and upholstery fabrics in cooperation with long-standing partners, as well as various specialist products. Overall, its focus is on finding appropriate solutions for everything clients may want when it comes to interior design. The main factors in the choice of materials are ease of use and passenger safety.

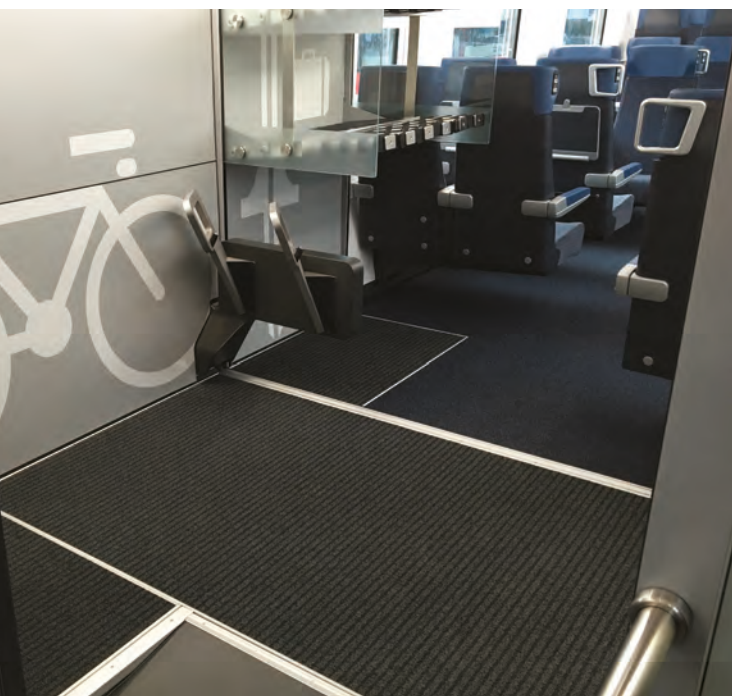
Important criteria for roller blind systems include quiet operation, full height adjustability and the use of fire-tested materials in modifiable colors. The elements Tde supplies are ready to fit, so installation is easy to integrate into the production process. Ease of service and low lifetime costs are also important factors in the customer's purchasing decision.

Tde's shading systems are continuously improved in terms of handling, ease of use, mounting time and fire certificates, following new requests from customers or knowledge gained through internal development. One new shading system was developed to allow continuous adjustment without jamming, even in the case of large windows and upper-deck windows with curved guiding. The assisting cord is intended to ensure consistent parallelism.



The requirements of vehicle designs and materials are becoming increasingly complex

Jürg Scheu, Texat decor engineering



ABOVE: Tde uses 3D modeling and prototypes to tailor products for customers

ABOVE RIGHT: The company offers a variety of shading systems for both passenger cars and the driver's cab

LEFT: Tde also supplies floor coverings and upholstery

For the driver's cabin, the company engineered an electrically operated roller blind that can be manually operated in the event of electrical problems. As front windows become more inclined, an electric roller blind that uses weights is no longer viable.

Heavy-duty fabrics and flooring

Functionality, design, quality and the use of flame-resistant and easy-care fabrics that are suitable for very heavy-duty use are the main requirements for train seat covers. Many of Tde's designs are custom-made to suit a company's corporate identity. In conjunction with a partner, Tde designs new color schemes or a completely new fabric design according to specifications. The seat and back covers can be laminated to make them waterproof, which greatly extends the service life of upholstery.

A defining factor in the design of Tde's anti-dirt mats is that the majority of dirt and moisture is retained in entrance areas. Carpets are designed with an open structure, highly durable material and special backings that enable rapid installation and replacement. Floor coverings must be quick drying and easily cleaned. They can also be customized with intarsia designs and finished edges.

Customer collaboration

Tde aims to work with designers and engineers from the start of the project. In practice the company is often given concept drawings, or takes measurements directly from the carriage and then translates the requirements into custom-made products using CAD and/or prototypes.

"More and more people are using public transport, so performance must be continually improved," says Jürg Scheu, managing director at the company. "This means that the requirements of vehicle designs and materials are becoming increasingly complex. To meet these demands, we develop ideas and translate them into new products, services or processes that are then introduced successfully into the market."

Notable past projects have included anti-slip coasters for Switzerland's Golden Pass Line and, outside the rail industry, supplying components for blood analyzers to an international pharmaceutical company.

Meeting of minds

Railtex, the international exhibition of railway equipment, systems and services, returns to the National Exhibition Centre, Birmingham, UK, May 14-16, 2019

Firmly established as a premier exhibition of railway equipment, systems and services, Railtex provides the industry with a showcase of technical innovations across all sectors of the rail supply market.

"The scope for new business opportunities in rail is huge, with record levels of investment and a growing demand for modern and improved systems and assets fueling an overhaul of the UK's network," says Kirsten Whitehouse, exhibition manager for Railtex. "Large-scale projects including the HS2 high-speed line, Crossrail 2 and Transport for the North's £70bn [US$94bn] masterplan, as well as extensive government aspirations for CP6, lead the way for market growth."

First staged in 1993, Railtex continues to enjoy strong support from all organizations shaping the UK's rail industry and has built its reputation as a premier networking event by continuing to attract visiting managers, engineers and buyers at the highest level.

LEFT: Railtex attracts key decision makers, purchasers and engineers

ABOVE: A wide range of railcar interior products, technologies and services will be on show

Interior products

This year will see the 14th Railtex, providing companies serving all aspects of the infrastructure and rolling stock sectors with the perfect platform to demonstrate their capabilities, do business and meet customers. Beyond track and infrastructure, Railtex will bring together a host of companies exhibiting a broad range of railcar interior products, technologies and services, making the show an important event for key decision makers, purchasers and engineers within major rail vehicle operators.

The biennial exhibition attracts an international audience to a three-day program that also includes keynote speeches, discussion forums, CPD-certified industry seminars and project updates from a host of high-profile names, providing valuable insights into development of policies and technologies for the industry.

When it was last staged in 2017, the event enjoyed its highest exhibitor and visitor numbers for 20 years. Railtex 2017 attracted 475 exhibiting organizations and almost 10,000 rail industry professionals. A total of 7,052 trade visitors attended Railtex 2017, with an additional 2,703 people present as exhibitors.

BELOW: 2017 saw the highest visitor numbers in 20 years

Global appeal

Reflecting a strong interest from outside the UK in opportunities in both the UK rail market and capabilities of the country's supply sector, more than 13% of visitors in 2017 were non-UK nationals, from 50 different countries, while almost 100 exhibiting companies came from 23 other countries. "In 2019, with business opportunities increasing and the UK clearly the most important market for those working across the rail industry, the number of exhibitors and trade visitors is expected to reach further record levels," says Whitehouse.

"We're delighted to be returning to the NEC in 2019. Railtex 2019 will lead to significant numbers of successful business transactions and connections being made and is once again set to exceed the expectations of exhibitors and trade visitors."

Railtex 2019 will be the most extensive show to date. "With record levels of investment and a wealth of opportunities available across the whole industry supply chain, there's never been a more important time to have a presence at the exhibition," says Whitehouse. "This is the place for rail industry professionals to meet, network, learn, discuss, do business and discover the latest trends, technologies and innovations within the rail sector. We're looking forward to welcoming back a mix of both national and international companies, as well as many new ones, to exhibit alongside an exciting and stimulating educational support program."

LEFT: Hitachi's vertical scroll compressor for transportation applications

RIGHT: The shorter, horizontal version

Cool customers

The train market has embraced Hitachi's air-conditioning scroll compressors - and they are now finding new applications in the electric bus sector

Within its diverse range of air-conditioning products, Johnson Controls – Hitachi Air Conditioning (a joint venture established by Johnson Controls and Hitachi Appliances) offers horizontal and vertical scroll compressors designed exclusively for the transportation sector. They have been developed to provide the benefits of a compact size, light weight, high reliability, and minimal noise and vibrations.

The horizontal scroll compressor is particularly optimized for space saving. It is 198mm (7.8in) long and weighs 34kg (75 lb), enabling HVAC manufacturers to make their units shorter and lighter than standard units that use a vertical compressor. The company points out this creates more space for passengers to enjoy, while also saving energy.

Built to last

Reliability was a key goal in the development, and thus the products bypass the need for thrust bearings. Instead, an orbiting scroll plate is supported by intermediate pressure. The gap between the orbiting scroll and the fixed scroll is controlled in microns. These gaps are uniform and few, the spaces between components are sealed with oil, and there is no need for tip seals. Hitachi says minimizing sliding parts in its compressor means there is little friction and less chance of damage, plus less chance of the refrigerant leaking.

A range of inverter compressors are also available. These are designed to help HVAC units to run more efficiently by enabling precise temperature control. The company says this results in lower running costs than fixed-speed systems.

Building on the range's success in the train HVAC market, Hitachi's compressors have recently made inroads into the electric bus sector. Hitachi notes electric buses are rising in popularity, as demand grows for environmentally friendly, energy-saving transportation options. Electric buses run on electricity provided by onboard batteries. The HVAC system is one of many components that relies on this supply of onboard electricity; therefore, efficient use of the electricity is vital. Space saving is another key factor. Due to these considerations, Hitachi contends an inverter compressor is the most suitable solution for HVAC units on electric buses. In particular, the company says its inverter scroll compressors are ideal because a wide range of models are available – including horizontal and vertical, AC and DC inverter types.

Efficient operation

Battery cooling is another application for Hitachi's compressors on electric buses. The company says a battery can build a high temperature, and it needs to be cooled for optimum performance. Hitachi's horizontal scroll compressor, with its small size and light weight, enables it to be installed on the roof of the electric bus, making it ideal for battery cooling.

Hitachi has more than 50 years of experience as a supplier of air-conditioning compressors for the transportation industry and started making scroll types in 1983. After initial success in the domestic market, the company began exporting its compressors for use on foreign projects from 2006. It has supplied more than 100,000 compressor pieces for more than 100 projects in 30 countries. All research, development and design activities are handled at the company's headquarters in Japan. Manufacturing is conducted at Hitachi's factories in Japan and China.

Style and substance

Pressure forming can unlock the aesthetic flexibility of thermoplastics, boosting their case as an alternative to composites and metal

LEFT: Pressure-formed components can rival the look and feel of advanced composites

Today's thermoplastics deliver a huge palette of colors, textures and geometries to enhance the passenger experience while reducing maintenance requirements and exceeding technical specifications. "New materials from the leading polymer and plastic manufacturers are improving mechanical properties and flame, smoke, toxicity [FST] performance, as well as reducing the weight-to-volume ratio," says Geoffrey Young, transportation product line manager at Brentwood.

Pressure forming processes offer the ability to impart different textures and design features with crisp definition, while fluoropolymer film-capped thermoplastics offer the level of graffiti resistance expected in railcar applications and the ability to incorporate a decorative aspect. "Combined, these elements are pushing interior aesthetic expectations to new levels," says Young. "It's critical to consider the aesthetic element early in the design process, ensure the technical specifications are right for the application, and work with an experienced thermoforming partner capable of supporting the needs of engineering and design, supply chain management and component production."

Pressure forming plastics

Young contends that the pressure forming process yields components that rival the look and feel of advanced composites, fiberglass-reinforced plastics and injection-molded plastics, but at a lower cost. "Complex geometries and undercuts are made possible because edges and corners can have smaller radii, and tighter tolerances for precise-fitting components produce more appealing interiors," he adds. "Texturing is more uniform and precise with pressure forming as well, because the texture application is inherent to the manufacturing process itself; random designs, wood grains and geometric patterns of varying depths are all achievable where they might not be under traditional forming or composite techniques."

BELOW: Edges and corners can have smaller radii, making complex undercuts possible

Pressure forming also permits embossed text, logos, braille, symbols and icons to be incorporated in the design of the component, and multiple design elements can be formed on a single component.

The use of thermoplastics in railcar interiors has been expanding in recent years. "The benefits of weight savings, improved mechanical properties, recyclability and advances in aesthetics have brought plastics into the spaces historically occupied by fiberglass composites and metal components," says Young.

That said, when converting composite or metal designs to thermoplastics, it's imperative to choose a knowledgeable supplier with strong engineering capabilities to reduce development time and design issues, as well as improve final quality. When the design, manufacturing and assembly of thermoplastics subcomponents are extended to a tiered supplier, it's also critical that attention is given to the quality systems in place. Young recommends looking for a robust system specific to the rail industry, such as IRIS.

Ready for installation

As more efficient assembly line techniques find their way into railcar manufacturing, the importance of delivering an assembled item ready for installation becomes more important. Young says the expectation on plastics manufacturers has grown to include not only forming the part, but completing sub-component assembly to deliver assembly-line-ready components. "This yields obvious advantages for the builder, such as reduced assembly time and complexity," he adds. "Car builders can also benefit through reduction of quality rejection resulting from component tolerances and internal processes, reduced SKU volume and better management of inventory turns."

Lighting in trains has to cope with shock and vibrations, surge and transients

Bright ideas

LED retrofit lamps offer many advantages for rolling stock, but their design must consider the sector's environmental challenges and complex standards

LED technology is now well established and the potential energy savings, maintenance savings and reliability advantages are well understood. Retrofit LED technology replacements for traditional lamp types have become popular across a wide variety of applications and have been readily available for some years.

"It is often overlooked however, that unlike a traditional lamp, which is purely a passive device, an LED replacement is a piece of electronic engineering typically involving elements of drive electronics, light engine, lamp caps, optics and interconnections," says John Hesketh, managing director at LPA Lighting Systems. "Unlike a conventional light bulb, the LED emitter requires constant current drive and therefore cannot be connected directly to the power source, hence the need for converting, or drive, electronics."

An LED lamp is a piece of electronics and therefore must be designed and tested to all applicable rolling stock standards for electronic equipment.

Challenging conditions

The train interior is an arduous environment for electronics. "Not only are there shock and vibration and severe temperature extremes to consider, but electrical conditions are demanding," says Hesketh.

"Supply voltage variation ranges alone can present a design challenge – and that's before considering the excessive surges and transients superimposed on this voltage. Then there is the matter of EMC, where both emissions and immunity standards need to be considered. Not only should the device not emit, it should also work in the presence of electrical fields and disturbances."

There are standards that specifically apply to electronics and lighting products in the rolling stock environment. Most of these are now European norms (EN) and relate to newly constructed or modern rolling stock. The fundamental EN standards are EN 50155 (electronic equipment used on rolling stock), EN 61373 (shock and vibration), EN 50121-3-2 (EMC performance), EN 45545 (fire testing of materials and components for trains) and EN 13272 (lighting performance).

ABOVE: LPA's entire range of retrofit LED lamp products meets all applicable rolling stock standards

"Newly manufactured rolling stock would typically utilize an LED lighting solution from the outset, which is the most effective use of the technology, offering maximum reliability and service life," says LPA's Hesketh.

Rolling stock undergoing mid-life refurbishment will often utilize part of the original lighting solution or ceiling in conjunction with replacement LED gear trays to provide a refreshed interior with all the benefits of the technology.

"In the case of older rolling stock where a prolonging of life is required with minimal budget, there is often the need for a retrofit LED lamp that will simply drop in to the original lamp position," Hesketh adds. "Older rolling stock is often prone to excessive surges and transients associated with the lighting control supply, and more demanding technical standards – pre-dating current European norms – may apply."

LPA Lighting Systems' entire range of retrofit LED lamp products – which includes variants for all vehicle control supply voltages – has been designed and tested in accordance with all applicable rolling stock standards and European norms.

"Importantly for older rolling stock in the UK, they have also been designed and tested to the RIA 12 surge and transient standard," concludes Hesketh.

Cover stars

New rail-specific genuine leather and synthetic upholstery options are available from Perrone Railway

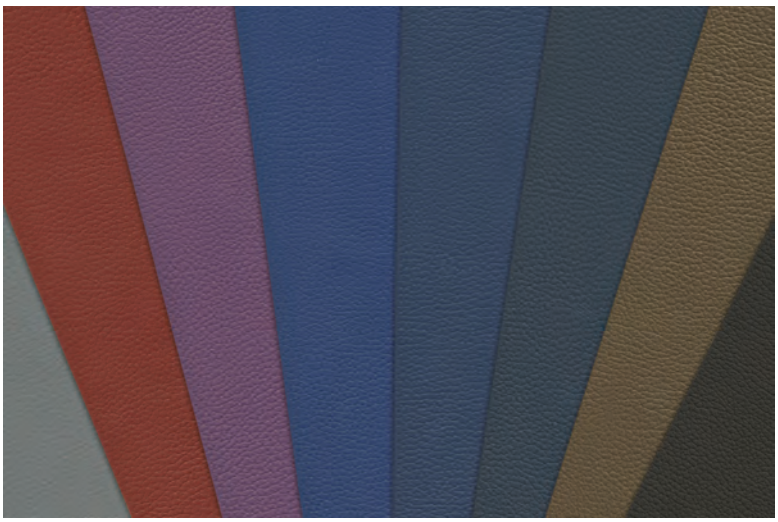
The commercial, corporate and VIP aerospace markets have long called upon Perrone Aerospace's expertise in the manufacture and supply of performance leathers and textiles. "Boasting more than 100 years of combined industry experience, and customers all over the world, Perrone technicians are considered craftsman in the production of all ranges of genuine leather," says Marc Cognetti, director of marketing at the company.

The company's line ranges from its most durable, lightest-weight leather for heavy-use commercial applications, to its softest and most luxurious products for VIP projects.

New lines

Recently, Perrone Aerospace leveraged this wealth of experience to create its newest line of products specifically for railway applications. The company says the two sectors have similar technical and design requirements. Perrone Railway is continually developing new products, including noise-canceling materials, to meet the evolving demands of this growing market.

The new rail developments include a line of synthetics designed to be light weight and durable, and a broad range of genuine leathers. The range has been collated to meet the needs of all rail applications – from metro to commuter and high-speed services. It has also been developed to meet or exceed the highest standards for performance and durability, including EN44545-2/HL3, BS 6853 and DIN 5570.



ABOVE: The Stellar range of natural leather for rail applications

"The key factors of importance to customers when it comes to seating upholstery are durability, maintenance and cleanability – and weight savings are of increasing consequence too," says Cognetti. "Perrone Railway offers solutions that address all of these requirements. All our railway leathers are manufactured with a proprietary anti-soiling finish. Our premium synthetic product offers a closed-cell anti-graffiti urethane skin that will not delaminate from the backing over time. It is also the lightest weight and most durable synthetic in the market, is ink and stain resistant, easily cleaned and inherently antimicrobial."

ABOVE AND RIGHT: EnduraLite, Perrone's lightest-weight synthetic leather

Track record

Perrone Railway has worked with customers including Amtrak, ViaRail, Bombardier, Siemens and Compin.

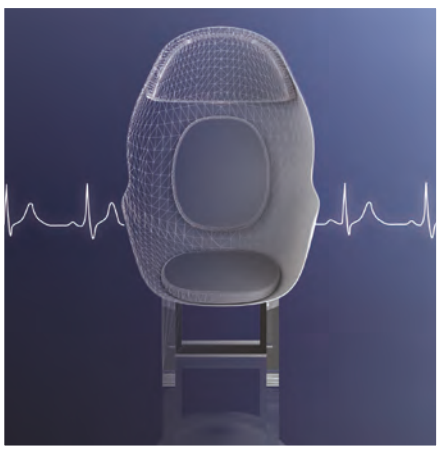
Rounding out the offering, Perrone offers a complete line of cleaning chemicals to keep genuine leather, synthetic and even fabric upholstery looking like new.

As well as its headquarters in the USA, Perrone Railway also has sales offices in Europe and Asia to support its global rail customer base efficiently.

The company's latest collection will be on display at InnoTrans 2018 – to be held in Berlin, Germany, on September 18-21. The company's stand is number 219 in Hall 5.1.

Making sense

The latest developments from THK include a 'sensoroid' and a smart seat, used to obtain health and environmental data



ABOVE: The Argus Mova sensing chair

RIGHT: The Atmos 'sensoroid' from THK

Sensing specialist THK has developed a 'sensoroid', Atmos, that can be used to gain data on various aspects of its surrounding environment. Atmos is shaped like a human, formed by gray acrylic sheets arranged around a white frame. Sensors can be embedded all over the unit, in between the acrylic sheets. In the prototype, the sheets are positioned at 15mm (0.6in) intervals. The company's FBL27D slide rails are used in the chest area, and a microcomputer or other device can be installed as well. THK's RF77F cross-roller ring is used in the waist area. The sensor data is displayed on a separate monitor.

The Argus Mova smart sensing chair is another recent development. High-sensitivity piezo sensors are incorporated into the seat, enabling heart rate, respiration rate and other parameters to be detected based on minute movements of the human body.

THK envisages the product being used for seating in cars, trains and aircraft, as well as other applications. The product is designed to have a futuristic aesthetic to match its technological features – with a white shell-type seat and legs made of transparent acrylic.

Both products are part of THK's Argus Smart Sensing concept, whereby information is collected through sensors, analyzed using an original algorithm, and visualized on a PC or smartphone.

Argus Mova was created using the company's Sensor Palette design framework, which is under development and will be offered as a service for IoT/sensing design projects. Sensor Palette is designed to be a universal, reusable software and hardware kit incorporating sensors, microcomputers, network technologies, batteries and methodologies for visualization.

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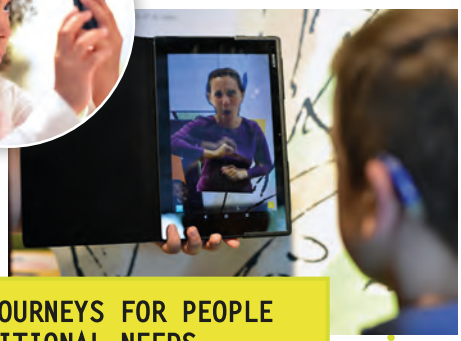
DOWN THE LINE

Three innovative rail projects worth keeping an eye on...



INDUSTRY 4.0 PRODUCTION

Bombardier Transportation aims to kickstart the Industry 4.0 revolution at its site in Bautzen, Germany. It has opened a new final assembly hall, at a cost of €8m (US$9.4m), that will be capable of producing 600 train cars a year. The focus is on an increased use of digital technologies and greater efficiency – Bombardier says that the new hall will save around €1m (US$1.2m) each year in terms of logistics, energy and maintenance costs compared with its predecessor.

Regional, intercity, suburban and underground trains, plus trams, will all be made there. Three vehicle types can be produced simultaneously. The factory has 8,100m² (87,188ft²) of floorspace and will have 500 staff.

"The goal here is to set future standards for Industry 4.0 production in the railway industry," said Saxony's Minister of Economic Affairs, Martin Dulig, at the opening ceremony.

EASING JOURNEYS FOR PEOPLE WITH ADDITIONAL NEEDS

The UK's government has awarded £600,000 (US$800,000) in funding to be shared between seven high-tech projects aimed at making train travel easier for passengers with additional needs. The schemes include developing a toolkit with an augmented reality app called Signly to deliver key information in sign language on staff smartphones and tablets, benefiting people who use British Sign Language.

The other projects include a website providing passengers with information on the accessibility of stations; a tool to help station accessibility planners identify problems; a journey planner offering bespoke guidance; an app to help people with autism plan journeys in line with stress-related preferences; an app to enable station staff to prioritize PRM requests; and a study to increase staff understanding of less visible impairments, such as dementia.

REVOLUTION VERY LIGHT RAIL VEHICLE

An industry consortium in the UK is developing a rail vehicle that they say will have a tare weight of less than 1 metric ton per linear meter, thanks to lightweight materials and a modular structure, enabling it to run on lightweight modular slab track. The Revolution VLR (very light rail) vehicle will be an 18m-long (59ft), bidirectional car with capacity for 56 seated passengers and 60 standing.

The consortium is led by Transport Design International and also includes rolling stock owner Eversholt Rail, WMG at the University of Warwick, Cummins and others from the automotive and rail sectors. More than £3m (US$4m) is being invested by the Department for Transport through the Rail Safety and Standards Board.

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