



# informer

DECEMBER 2018 - THE CUSTOMER  
MAGAZINE OF KNORR-BREMSE GROUP  
RAIL VEHICLE SYSTEMS  
EDITION  
49

## NEWS

### **InnoTrans trade fair roundup**

## SPOTLIGHT

### **"Think global, act local"**

Manufacturing excellence with the KPS production system

## CUSTOMERS + PARTNERS

### **"Rock" and "Pop"**

New regional trains for Trenitalia

## PRODUCTS + SERVICES

### **Ecodesign**

Life cycle analyses for more sustainability

**KNORR-BREMSE**





# contents



## editorial

- 03** Dr. Peter Radina  
Member of the Executive Board  
of Knorr-Bremse Systeme  
Schienenfahrzeuge GmbH

## news

- 04** Systems.People.xConnected:  
Reflections on InnoTrans 2018
- 08** RailServices: Complete braking system  
upgrades thanks to EBA authorization
- 09** EKA: New software for  
MI-8 Transformer brake test bench

World events

## spotlight

- 10** Think global, act local: Manufacturing excellence  
with the Knorr-Bremse Production System KPS

## customers + partners

- 14** "Rock" and "Pop": New regional trains  
for Trenitalia
- 16** Always on the move: New service models  
with RailServices

## products & services

- 18** Ecodesign: Life cycle analysis  
for greater sustainability
- 20** Friction Technologies:  
Friction material know-how comes into play
- 22** Dawn of a new age: Power supply with PowerBriX
- 24** Economy vs. ecology: An HVAC system manages  
the balancing act
- 26** Sand on demand:  
Speed-dependent sanding systems





Dr. Peter Radina,  
Member of the Executive Board  
of Knorr-Bremse Systeme  
Schienenfahrzeuge GmbH

INFORMATION FOR  
KNORR-BREMSE'S CUSTOMERS  
AND BUSINESS PARTNERS

#### IMPRINT

Publisher: Knorr-Bremse  
Systeme für Schienenfahrzeuge GmbH  
Marketing: Katharina Bachem  
Moosacher Straße 80  
80809 Munich  
Germany  
Tel. +49 89 3547-0  
Fax +49 89 3547-2767  
www.knorr-bremse.com

Realization: KB Media GmbH, Carina Smid  
Layout, graphics: KB Media GmbH,  
Jacqueline Comes  
Text: Thorsten Rienth  
Printed by: Pera Druck GmbH



## Dear reader, Rail is booming!

There is no other way to sum up this year's InnoTrans fair. With every square meter of the Berlin exhibition grounds occupied, the fair hosted 3,062 exhibitors, over 150,000 trade visitors from no fewer than 149 countries – and 155 world premieres. Once again, our industry impressively demonstrated its innovative strength and sustainability – two keywords closely associated with Knorr-Bremse. They are evident in the way we use modular products and longer maintenance intervals to leverage savings potential. They are evident in the way our more efficient entrance systems speed up processes on platforms and improve passenger comfort. They are evident in the way our optimally controlled HVAC systems equipped with new coolants reduce both energy consumption and environmental impact. And, of course, they are evident in the way train frequency is increased thanks to our more efficient braking systems.

Developing the underlying products and systems is one thing. Producing them is another. In this issue of informer we are turning the spotlight on this often largely overlooked process – and more specifically on the Knorr-Bremse Production System (KPS) and how it reflects Knorr-Bremse's key approach of "think global, act local".

The goal of KPS is nothing less than to establish the company's principle of excellence on the same high level at every single stage of production and at all our facilities worldwide. The key themes are process organization, operational efficiency, logistics and quality. The task is not an end in itself, of course. Taking three examples of best practices, our aim is to demonstrate how our customers benefit very directly.

But in this issue of informer we are also illustrating this added value by means of specific products, systems and services. At the moment, for example, we are working hard to integrate the friction know-how we acquired this summer into our portfolio. This know-how enables us to offer the appropriate friction material for virtually every type of train – in both the original equipment and aftermarket businesses. With our new PowerBriX converter generation, we are ushering in a new era in power supply for rail vehicles. And last but not least, we are using this issue to present our new service models from RailServices. Different as they are, one thing applies to all of them: Nothing beats genuine added value. Why not read about them for yourself?

I would like to take this opportunity to wish you and your loved ones a restful festive season and a successful start to the New Year.

Yours sincerely,

Dr. Peter Radina

# news







## BERLIN ROUNDUP

A string of successes at InnoTrans 2018: **Knorr-Bremse** is delighted reports several new business deals, including an extensive maintenance contract with Siemens Mobility, a new cooperation agreement with Perpetuum and a groundbreaking pilot project with DB Regio.

# news

**Knorr-Bremse chose the slogan “Systems.People.xConnected” for its four exhibition booths at the Berlin trade fair. This slogan expanded on the connectivity trend, placing the focus on customers, passengers and a coherent environmental and social responsibility agenda.**

One example is the new EP2002 3.0 brake control system, which introduces several optimizations to its extremely successful predecessor and extends its applications to metros and regional trains. Another case in point is the roof-mounted equipment con-

tainer, in which Kiepe Electric perfectly integrates its core competencies of traction, on-board power and control functions in a single unit. The container’s extremely low profile allows customers to save space by installing it on the vehicle roof.

Meanwhile, the passenger dimension is addressed by products such as IFE’s innovative door sealing system. Because this solution forms an integral part of the entrance system, it enhances the sliding door’s acoustic insulation, significantly improving passenger comfort.

Show-stopper – the main Knorr-Bremse booth in Hall 1.2 ▼





## InnoTrans – the ideal platform to drive forward specific solutions

**The Company's focus on the market drivers of system connection, life cycle efficiency, transport capacity and ecode-sign has proven its worth: "Our solutions add genuine value and fully meet the requirements of vehicle manufacturers and rail operators around the world," concludes Dr. Jürgen Wilder, Member of the Executive Board of Knorr-Bremse AG with responsibility for the Rail Vehicle Systems Division. "InnoTrans once again proved to be the ideal platform to drive forward specific solutions."**

This is demonstrated, for example, by Kiepe Electric's project to pilot an innovative HVAC technology with Deutsche Bahn. Instead of using a refrigerant based on environmentally harmful CFCs, the solution employs natural and significantly more eco-friendly CO<sub>2</sub>. The difference is striking: The Global Warming Potential (GWP) of CFCs is between one and two thousand times that of CO<sub>2</sub> (GWP 1). The unit is based on a system already being used on a VT 642 diesel-electric vehicle belonging to the Chemnitz-based rail operator Erzgebirgsbahn. The new pilot agreement relates to two adapted systems for DB Regio double-deck passenger cars.

### Cooperation with Perpetuum

Knorr-Bremse has signed a declaration of intent with Perpetuum regarding cooperation on condition monitoring of vehicle sub-systems. The aim is to combine Perpetuum's system for recording and monitoring vibrations of wheels, gearboxes, motors and wheel bearings with the Knorr-Bremse RailServices iCOM platform. This will further enhance diagnostics, enabling longer maintenance cycles and improved availability, for example.

Knorr-Bremse also invited Düsseldorf rail operator Rheinbahn to present its implementation of the iCOM platform in light rail vehicles. Online transmission of condition data from moving LRVs has significantly improved Rheinbahn's organization of workshop operations, reducing vehicle downtime and cutting operating costs.

### Agreements with Siemens Mobility

Knorr-Bremse was also able to seal a number of concrete business deals at the trade fair. For instance, a long-term maintenance agreement covering multiple countries was concluded with Siemens Mobility. RailServices will carry out the braking system maintenance of all the Desiro and Velaro fleets that Siemens is responsible for maintaining in the UK and Russia, as well as its current locomotive fleets at European level.

A declaration of intent was also signed regarding the incorporation of iCOM apps into the Siemens Mobility application suite Railigent®. The combination of Knorr-Bremse's comprehensive components and systems know-how and Siemens' exceptional maintenance expertise will help to further increase the availability of customers' fleets.

▼ Exhibits at the company's main booth



# news



Vehicle operated by Chemnitzer Erzgebirgsbahn

## EBA authorization granted

**RailServices can now offer Desiro Classic VT 642 operators the ESRA 3.0 braking system upgrade, including vehicle homologation.**

Knorr-Bremse RailServices has now expanded the scope of its offering from conversion only to include the final remaining step: complete braking system upgrades, including final vehicle homologation, from a single-source provider. In September, in connection with the ESRA 3.0 upgrade project, the German Federal Railway Authority (EBA) for the first time issued a commissioning authorization to Knorr-Bremse Rail Vehicle Systems.

For Desiro Classic operators this makes life a great deal easier: If operators have RailServices fit their "VT 642" with the new brake control system, the vehicles then correspond to the Desiro Classic homologated by KB and, as such, automatically come with commissioning authorization. Although EBA approval cannot be transferred to the regulatory framework of another country one to one, as a rule the national authorities recognize German homologations with only minor additional certification.

In the project upon which series approval was based, RailServices equipped a vehicle belonging to rail operator Chemnitzer Erzgebirgsbahn with the new brake control unit, replacing the MRP control unit designed in the mid-1990s. The background: As the vehicles become older, the problem of obsolescence increases. For certain electronic components, spare parts provisioning has declined rapidly.



Behind-the-scenes view of the upgrade project ►



## New software for MI-8 Transformer brake test bench

**Intuitive in operation, easily transportable, robust, and capable of functioning in a wide range of temperatures: The MI-8 Transformer mobile brake test bench manufactured by Knorr-Bremse's Macedonian subsidiary EKA is hard to beat. Now the company has further improved the system, providing it with a new software platform and renaming it the Optimus 1.**

For the first time the new software enables custom test sequences and parameters to be set and processes customized for the particular application concerned – freight and passenger trains, EMUs/DMUs, locomotives or special vehicles.

As a further option an I/O hub can be used, which simplifies the testing process: A single, short cable connects the test bench with the hub, to which all the required sensors are then connected, also by considerably shorter cables. In practice this means



that, for example on long freight trains, the MI-8 Transformer HUB can test two distributor valves simultaneously, and an increased number of sensors can be linked up.



## 100,000 containers in 2020

The market has embraced rail transport between Europe and China with open arms: While it accounted for only 0.5% of trade in 2007, according to the European Union's statistical office (Eurostat), its share had more than quadrupled to 2.1% by 2016. In absolute numbers of freight trains per year, this means just under 1,500 traveling from East to West and roughly half that number in the opposite direction. In 2020 rail operator Deutsche Bahn plans to transport 100,000 containers between China and Europe. That would be double today's number.

### Avoiding odysseys

A ship sailing from the Chinese port of Shanghai to Rotterdam via the Suez Canal has to travel 20,000 kilometers. Sending goods from Europe to China by train, on the other hand, can cut the distance, depending on the points of departure and arrival, by up to 10,000 kilometers. Knorr-Bremse supplies one of the prerequisites for this shortcut: Many of the trains are able to operate in the Russian winter thanks to the resilience of the company's systems to extreme cold.

# spotlight

## MANUFACTURING EXCELLENCE

The **“think global, act local”** motto is key to Knorr-Bremse’s way of doing business. A look at the Knorr-Bremse Production System (KPS) reveals why this principle is particularly important on the production side of the business – and how it delivers direct benefits for customers.

The goal is nothing less than perfection in the organization and execution of our work – every single day, in every operation, for every component, and **at every one of Knorr-Bremse Rail Vehicle Systems’ 46 production facilities**. The different plants make everything from air dryers for heavy-duty locomotives in North America to load-controlled brake valves for Russian freight trains and hydraulic components for Chinese LRVs. But despite their differences, they all have one thing in common: **They are manufactured on the basis of the Knorr-Bremse Production System (KPS).**







▲ Inside the plant in Getafe, Spain

## A focus on excellence in every step of the manufacturing process

"KPS applies Knorr-Bremse's focus on excellence to every single step in the manufacturing process," explains Dr. Jens Elzenheimer, Vice President Production at Knorr-Bremse Rail Vehicle Systems. "We use the same production system all over the world – and it is mandatory for every single facility. This ensures that all our production facilities consistently meet the highest standards."

The key themes are process organization, operational efficiency, logistics and quality. This can encompass everything from clear guidelines for shop floor layouts to defined sequences for the different production steps or the use of approved tools. At the same time, specific local conditions are, of course, always taken into account.

KPS builds on the company-wide "think global, act local" principle in the specific context of production. Elzenheimer describes how its key driver is the continuous improvement of manufacturing processes connected with a clearly defined best practice sharing system. He goes on to explain what this might mean in practice: "If, for example, a particular tool proves to be especially useful for a given application, we search all of Knorr-Bremse's production operations for similar applications in order to establish whether and how the new tool could benefit them too." If it can add value, preparations are made for its implementation.

The KPS model is no longer confined to mechanical production operations and assembly work for the OEM business. "KPS methods are being used increasingly widely by our RailServices aftermarket business." And the administrative departments have also recently launched their first few projects.

### Transferability to other locations is key

This universal approach is the main focus of the annual KPS community World Meetings. The extent to which an idea can be transferred to other plants is one of the key criteria used to judge the World Meeting's KPS Best Practice Award for the best solutions from shop floor management. "As this delivers benefits right across the business, it is ultimately also to the advantage of our customers," says Elzenheimer.

▼ Top picture: Knorr-Bremse NY Air Brake, USA  
Bottom picture: Suzhou, China







# Three ideas, three continents



## **The “Automatic Deburring Station”**

### **KPS project in Watertown, New York, USA**

Watertown is one of two major production facilities belonging to Knorr-Bremse Rail Vehicle Systems in North America. At this site, the company’s subsidiary New York Air Brake (NYAB) produces a range of components and braking systems for the North American rail transportation market.

Deburring involves the removal of rough edges, fibers or splinters left over after the production process. By its very nature, the process is prone to relatively high variation in quality. One of the main reasons for this is the painstaking deburring routine, which until now was performed entirely by hand. The facility addressed this problem by introducing an automatic deburring station. Operators load the machined parts onto the robots, which then carry out the actual deburring operation themselves. An optical recognition system ensures that the correct deburring program is used for the current part. “Customers benefit from shorter delivery times thanks to the faster process as well as consistently high parts quality,” explains KPS manager Felipe Werner.

## **The “Quality Gates for HVAC Production”**

### **KPS project in Getafe, Spain**

Knorr-Bremse company Merak produces HVAC systems for several different rail applications at its Getafe facility near Madrid. A wide variety of production and assembly processes are employed to make the different units. “Until recently, quality control was carried out at the end of the lines,” explains Werner. However, based on the findings of KPS assessments and an in-house initiative, this end-of-line test has now been supplemented by a further four smaller quality gates. The customer was also involved in the design of the new process.

The quality gates are located at the transfer points between assembly stations. Werner highlights the advantage of this approach: “Detecting quality deviations much earlier means that they can also be resolved far more quickly. The detection rate is also higher.” In this instance, the customer benefits from faster delivery of their HVAC system.

## **The “Milk Run” KPS project in Suzhou, China**

The Suzhou site in China is the largest Knorr-Bremse Rail Vehicle Systems facility in Asia. The plant, which underwent its latest expansion only two years ago, is a key production facility primarily for the domestic market.

In order to meet high domestic content requirements, several external component suppliers located near to the facility are closely involved in the production process. In the past, this entailed point-to-point truck transportation between the Suzhou production facility and each individual supplier. “Coordinating the relatively large number of vehicles required was a rather arduous task,” explains Werner. “On top of that, the trucks were usually empty on the outbound half of their journey.”

This point-to-point transportation model was recently replaced by the “Milk Run”. The trucks now follow three carefully planned routes that take them to the different suppliers in a fixed sequence and at set times. “The shorter routes cut throughput times, meaning that the items are delivered sooner.”

# customers + partners

## Music takes to the rails

"Rock" and "Pop" are the names of Trenitalia's two major orders for regional trains from Hitachi and Alstom comprising 450 trains in all, including several sub-systems from Knorr-Bremse.

When the Italian operator Trenitalia, subsidiary of FS Group, presented its two latest regional transport flagships at InnoTrans in September, the motto #lamusicastacambiando ("The Music is Changing") was entirely fitting: "Rock" and "Pop", the names of these two trains, will be music to the ears of those who as of next year will benefit from a new era in Italian regional transport. Trenitalia is thus continuing its recent tradition of naming its trains after musical genres.

This package is one of Italy's largest rail orders of the last few decades: 300 double-decker "Rock" trains have been ordered from Hitachi Rail Italy, along with 150 "Pop" EMUs from Alstom Transportation. The first of these trains, each with a top speed of 160 km/h, will start carrying passengers as of mid-2019, and Trenitalia intends to complete commissioning of all 450 units within five years.

The "Rock" double-deckers from Hitachi will operate with four, five and six carriages. The five-carriage variant, measuring 136 meters in length, can accommodate as many as 656 passengers despite its roomy interior layout. Added to this are 18 bicycle spaces, and entry ramps for passengers with limited mobility. The "Pop" single deck, the first train of the new European Alstom Stream platform, will be configured as four carriage units, each fitted with more than 300 seats.

Hitachi Double Deck Rock. ▼





### Knorr-Bremse specialists on board for the test drives

Both trains are being given an unmistakably green touch: For its "Rock" trains, Hitachi is claiming energy consumption levels 30% lower than in comparable applications – and the same figure is given by Alstom. The "Pop" trains are also said to consist 95% of recyclable materials, with no toxic substances at all being used in their production.

As one of the major suppliers to these projects, Knorr-Bremse is playing a substantial role: The "Rock" is fitted with EP Compact brake systems that include compact RZTS disc brake calipers and axle brake discs supplied by Knorr-Bremse Rail Systems Italia. Some electrical components are supplied by Knorr-Bremse company Microelettrica, based in Buccinasco, northern Italy. Knorr-Bremse Rail Systems Italia is supplying the toilet systems, including units for passengers with limited mobility. The "Pop" trains will feature brake, door and HVAC systems from Knorr-Bremse evolved on those already installed in vehicles from the Coradia platform.

The Group's engineers and specialist are currently on board for the homologation of these new trains, and will be involved for the initial field testing in the first quarter of 2019.

Final assembly of "Rock" in the Hitachi facility. ▼



"Pop" and "Rock" exhibited at InnoTrans 2018. ▲



# customers + partners

## New service models

Rail transportation never stands still, either literally or in terms of the ongoing development of vehicle operation.

Service models must also evolve to keep up, and the solutions offered by Knorr-Bremse RailServices are no exception.

The competitive environment is getting tougher and tougher due to the continuing liberalization of rail transportation and the appearance of new competitors from emerging markets. At the same time, state-run operators in particular are demanding more sustainable and eco-friendly vehicle operation, reducing the margins from the running of fleets. This typically results in a heightened focus on life cycle costs and total cost of ownership. It has led to a trend away from product-based services and towards proactive service models.

The following four examples show how Knorr-Bremse RailServices can add genuine value in this area:

### Energy-saving Service

Knorr-Bremse uses its expertise to deliver significant reductions in energy consumption, which in turn greatly reduces the operating costs of customers' fleets. Its bespoke service model combines energy-saving solutions for braking, HVAC, door, traction and vehicle power supply systems with digital service products and, where relevant, DMU hybridization. Whenever there are opportunities to obtain public subsidies, RailServices includes them in the concept. The model allows payments to be directly linked to the energy costs saved by the operator.

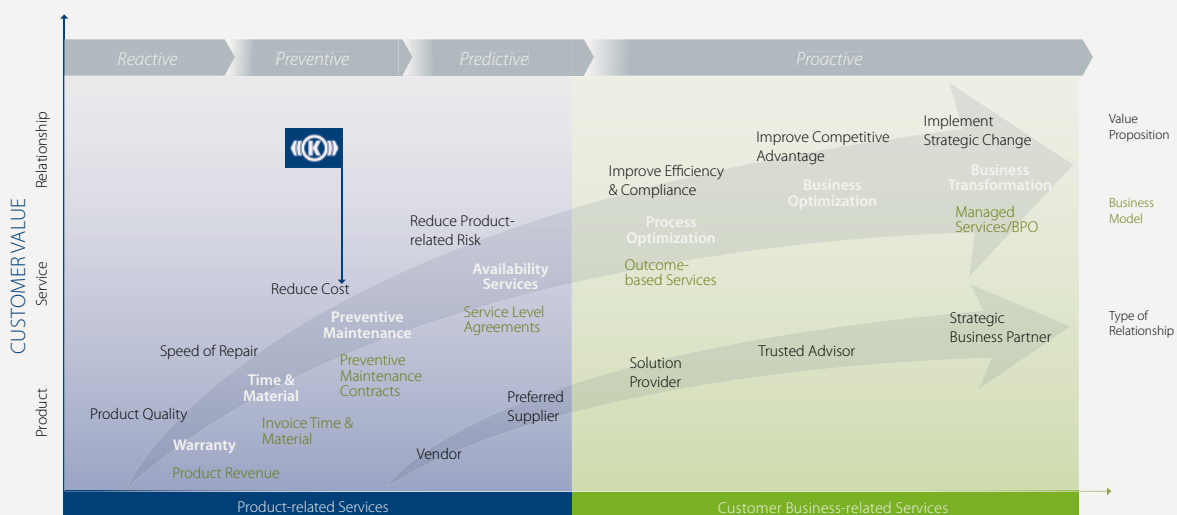
### Multi-vendor Systems Optimization

To be successful, operators have to focus on their core business and streamline their operations. They are not helped by having to coordinate different service providers for all the different vehicle sub-systems. As a one-stop provider, RailServices takes care of organizing all the maintenance and repair activities for a vehicle or fleet, with all the optimization benefits that this integrated approach offers.

Operators benefit directly from the resulting cost savings: It is almost always cheaper to use a single service provider than to have several different providers whose combined costs soon mount up. This approach also reduces the operator's overheads. Moreover, given proper planning, it is possible to carry out several service operations in parallel while the vehicle is in the depot anyway.

This helps to reduce vehicle downtime and also means that operators don't have to spend valuable time of their own on troubleshooting. Last but not least, the model allows operators to reduce their spare parts inventory in the depot, freeing up capital for them to modernize their fleet or acquire new vehicles.

### KNORR-BREMSE'S POSITION IN THE TYPICAL SERVICE BUSINESS EVOLUTION





### Availability Services

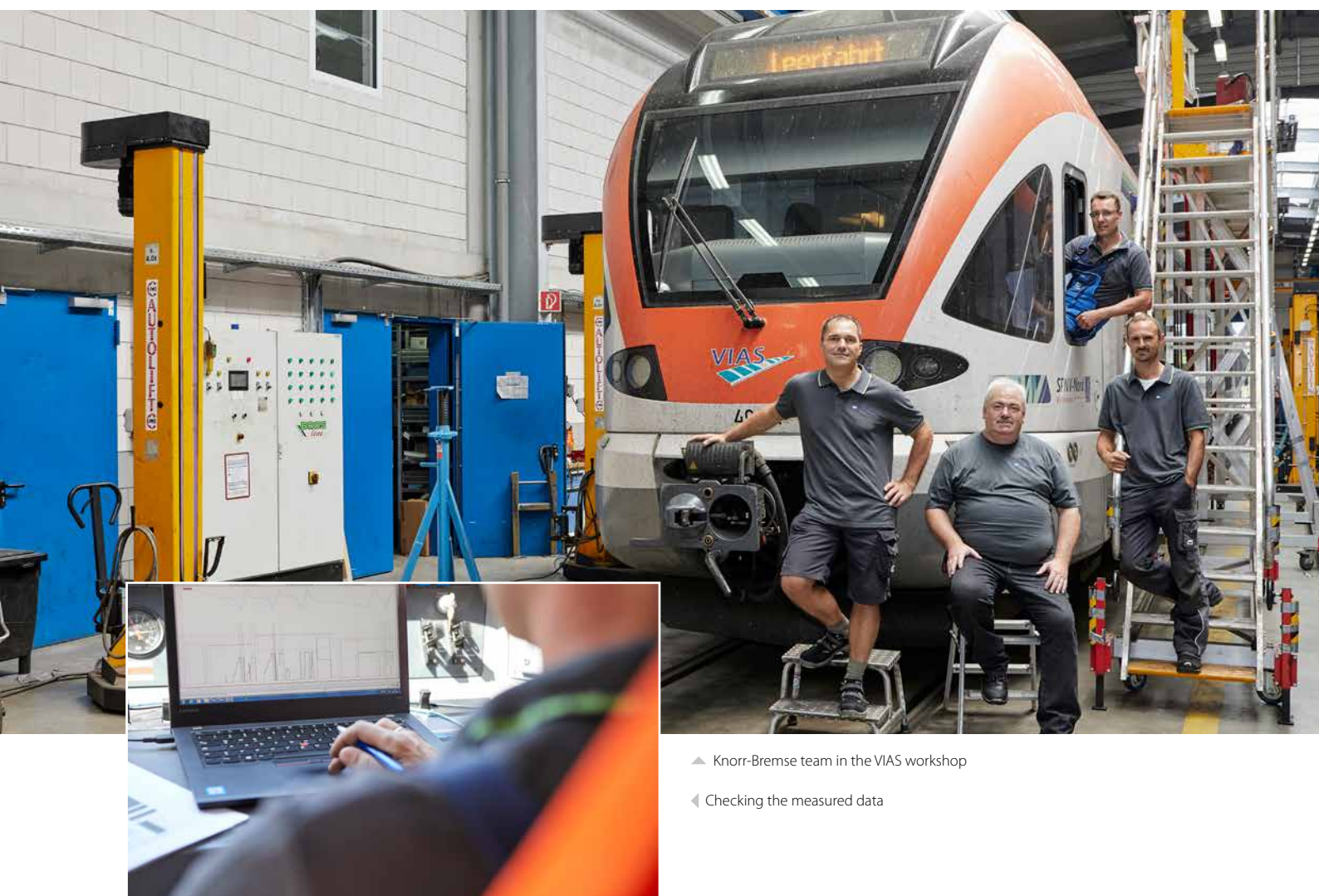
The contract between RailServices and the operator is based on availability assurances for spare parts rather than individual aftermarket services. The exact extent of the assurance is tailored to the operator's specific needs or wishes. It can cover anything from the availability of individual components or spare parts and/or obsolescence solutions to availability assurances for line replaceable units (LRUs).

Operators benefit from valuable support in ensuring the smooth running of their fleets, together with a lower total cost of ownership. The optimized availability of spare parts and critical operating components results in fewer product-related faults, leading to improved vehicle uptime.

### Life Cycle Optimization Services

Knorr-Bremse offers operators the opportunity to include all the Knorr-Bremse elements of their vehicles under a single long-term contract, while also equipping the vehicles with iCOM. As well as meaning that the same contract covers all Knorr-Bremse's products and services, the chief advantage is that the operating data obtained in this way can be used to optimize the vehicles' running and maintenance.

The hybrid payment model comprising fixed monthly payments and payments on delivery ensures that the potential benefits of these optimizations are shared between the operator and Knorr-Bremse. Knorr-Bremse can also take over and manage certain risks for the operator. At the same time, monitoring the vehicle's systems with iCOM ensures improved reliability and availability.



▲ Knorr-Bremse team in the VIAS workshop

◀ Checking the measured data

# products + services



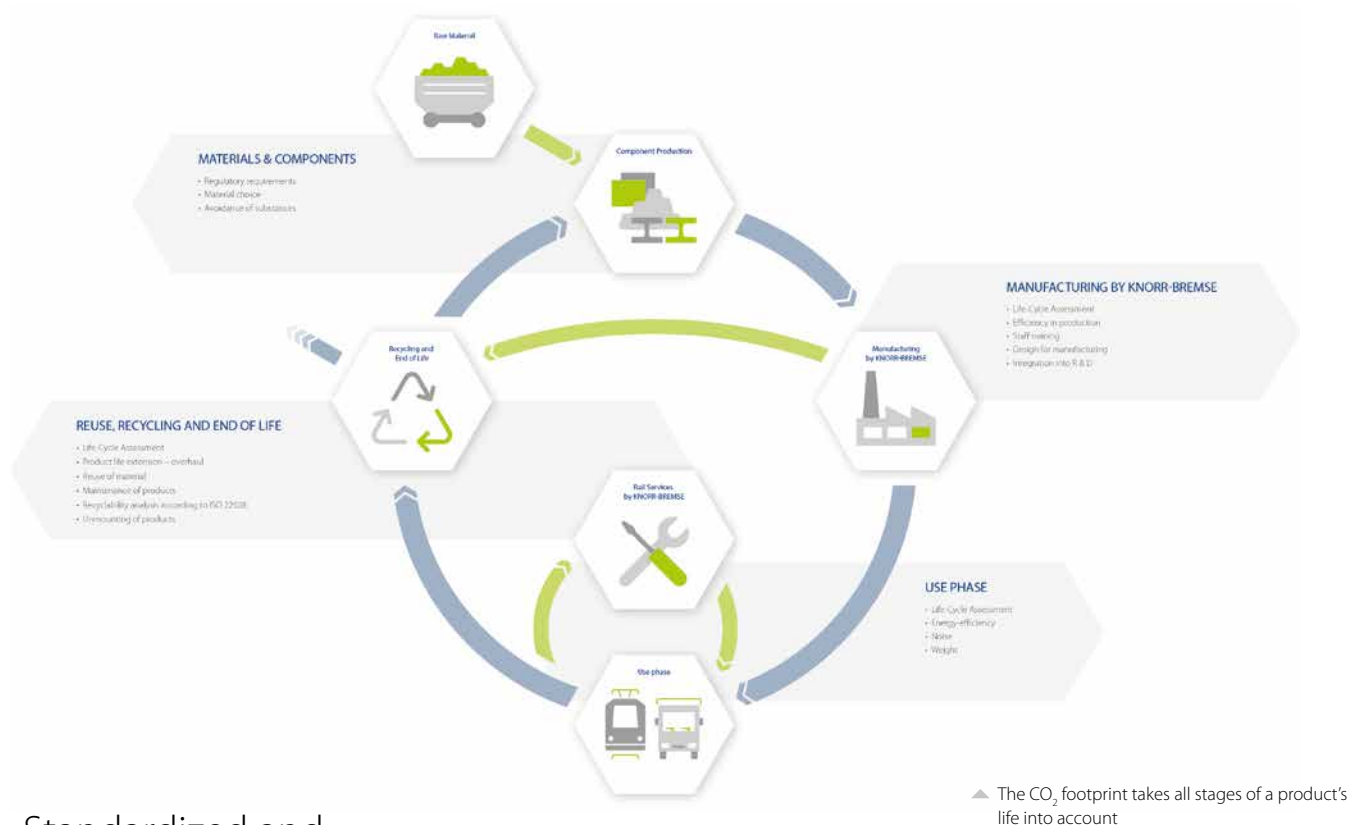
## ECODESIGN

**Anyone can claim to develop products that are more environmentally friendly. Knorr-Bremse provides the evidence with its life cycle analyses for selected systems.**

Of course, the focus of attention is on performance – the tangible added value for the vehicle manufacturer or operator. In the case of the intelligent electrohydraulic supply and control unit i3HU, for example, this means a system that is now connected directly to the train control management system via only a single standardized electrical interface, thereby radically reducing the amount of wiring required in the vehicle.

But there is also a second level that enables the advantages of i3HU to be quantified in comparison with its predecessor. "That is through the CO<sub>2</sub> footprint left by the system during its life cycle," explains Stefan Bräuherr, responsible at Knorr-Bremse for Corporate Responsibility.





## Standardized and transparent basis

This CO<sub>2</sub> calculation takes into account not only the material and energy consumption of the products and systems during operation, but also any material and energy consumption arising in the manufacturing, recycling and disposal processes. The calculation is based on the international standard for life cycle assessment ISO 14040 and the UNIFE product category rules. “In this way we have developed our analyses on a clear standardized and transparent basis,” says Bräuherr.

Evaluations for the intelligent electrohydraulic supply and control unit show a reduction in CO<sub>2</sub> emissions of approximately 15% compared with the predecessor system. Most of this saving results from the more efficient vehicle operation made possible by i3HU – for example, due to the reduction in the quantity of hydraulic oil that needs to be changed during service life.

And in the case of the new Light Weight Caliper, in fact, the CO<sub>2</sub> footprint is reduced by almost one quarter (24%) compared with a conventional standard brake caliper. The savings here are largely achieved as a result of reduced material consumption. This is thanks to an optimized design and is reflected in a reduced use of resources in all phases of the life cycle.

There are also additional savings from the operator's perspective, as the effects of weight reduction at vehicle level during service life are not taken into account in the calculation described above, which is based solely on the requirements of the standard. An example: For a Light Weight Caliper in a standard metro application and with a service life of 40 years, Knorr-Bremse calculates energy savings for the operator of 10 MWh per brake caliper.

For Knorr-Bremse subsidiary IFE's E4 entrance system, which is used in the double-deck cars operated by the DB Group, for example, calculations show a CO<sub>2</sub> reduction of around 8%. This example in particular demonstrates the importance of taking a differentiated approach to life cycle analyses. Although the CO<sub>2</sub> footprint in production may be a little higher compared with the predecessor model, lower-energy operation and greater material efficiency in overhauling the E4 more than compensate for the higher environmental impact in production.

### Cross-divisional working group

The reduction of product-related environmental impact is definitely a long-term issue at Knorr-Bremse. “We are continually working to design mobility that is energy-efficient, low on emissions and therefore environmentally friendly and resource-saving. And our life cycle analyses provide the evidence,” says Bräuherr.

In 2017, Knorr-Bremse set up a cross-divisional ecodesign working group with the aim of embedding sustainability at product level even more firmly in the product development process. The group brings together on a mandatory basis employees from Corporate Responsibility and the Rail and Truck divisions. “We are currently drawing up checklists to observe environmental aspects within product development. These incorporate findings from the CO<sub>2</sub> evaluations,” adds Bräuherr.



# Friction materials for almost every application

Since August, Knorr-Bremse has been gradually integrating into its product portfolio the friction know-how it acquired from Federal-Mogul. Within the foreseeable future the appropriate friction materials will be available for virtually all types of train.

The powders look like the ingredients for a Christmas cookie. They lie in small heaps on the work surface – some reddish or yellowish, some in tones of gray and black. But Sebastian Riedel, Director Business Development Friction at Knorr-Bremse Rail Vehicle Systems, has no culinary ambitions for his baking activities.

The comparison is nevertheless apt. “The way a combination of friction materials interacts with a brake disc is a complicated matter,” explains Riedel. “The composition of basic materials plays a key role here, along with the pressure in the mold, the temperature of the oven and of course the duration of the ‘baking’ process.” Even the slightest variation could significantly affect the braking properties of the friction pairings.

## Acquisition as part of ongoing strategic development

The integrated development of brakes and brake pads is crucial to optimal braking performance, noise reduction and lower life cycle costs – and all this in turn requires expertise in the development and manufacture of friction materials.

In August, Knorr-Bremse further extended its expertise in this field with its acquisition of the entire know-how of Federal-Mogul, along with property rights, for the development and production of friction materials in the rail sector and in industry. Despite such intensified activities in the friction material business, the competitive factor – an important aspect from the customers’ point of view – has been maintained: In return for the acquisition of its know-how, Federal-Mogul has received a grant-back license from Knorr-Bremse, enabling it to continue to provide its customers with high-quality friction materials.



▲ Powders for developing the optimum friction material combination



▲ A whole range of friction materials

# FRICTION TECHNOLOGIES

**PROPAD**

**PROBLOCK**

**OPTIPAD**

The acquisition is part of an ongoing process of strategic development in this product segment: Back in 2016, Knorr-Bremse acquired the railroad division of brake pad specialist TMD Friction, together with all shares in the Icer Rail joint venture. Anchor Brake Shoe, a leading North American manufacturer of brake blocks for locomotives and freight cars, has already been part of the Group for around ten years.

## Know-how integration initiated

"We are now integrating the new know-how into our friction material product portfolio step by step," says Riedel. In the foreseeable future Knorr-Bremse will thus be in a position to offer the most suitable friction material for almost every type of train. This applies both to original equipment and to retrofits.

The extension of the product portfolio goes hand in hand with an across-the-board renaming of the various materials. Knorr-Bremse is now grouping together the product technologies – sintered and organic materials, pads and blocks – under three Friction Technologies product segments: Propad, Problock and Optipad. The prefix Opti- signifies a sintered base material, while Pro- refers to organic material. The new scheme also makes use of the number suffixes already used in the industry. Cosid828, for example, now goes by the name of Propad828.

Riedel's conclusion: "With our extended product portfolio we can now provide our customers with even more specific support for their various applications over the entire life cycle. At the same time, with our rebranding we have created a more clearly structured nomenclature for our product portfolio."



▲ Dr. Carsten Peters (l.) and Sebastian Riedel  
from Friction Technologies at InnoTrans in Berlin

# A smart box for power supply

With its new PowerBriX converter generation, Knorr-Bremse PowerTech is ushering in a new era in power supply for rail vehicles – with features including high-performance silicon carbide (SiC) semiconductors.

Compared with other vehicle sub-systems, onboard power supply has had a relatively low profile in the past. "It shouldn't be that way," says PowerTech Managing Director Jure Mikolčić. "After all, it is immensely important for the efficient operation of modern rail vehicles." With increasing requirements on passenger comfort, energy demand for individual consumers – HVAC systems, onboard restaurants, power sockets or information display units – is on the rise, along with a desire for enhanced environmental protection through weight reduction. "This all calls for a revolution in power converter solutions." PowerTech is fully catering for this demand with its new PowerBriX converter generation.

## **PowerBriX: A modular design for maximum flexibility**

The power converter specialist in the Knorr-Bremse Group achieves the necessary flexibility with a modular system of type-approved master and slave modules. "Since they're standardized for various voltages and power ratings, they can be flexibly combined into a complete system as required for specific applications," explains PowerTech Sales Director Dr. Bertram Langhanki. A broad range of predefined options also makes for flexible adaption to highly specific customer needs. "With this modular approach on a system level we can set ourselves clearly apart from the competition," says Langhanki.

Vehicle manufacturers benefit from considerable reductions in integration and configuration costs for their vehicles. For vehicle operators, the combination of standardization, modularization and highly compact design increases both the energy efficiency of the onboard power supply and ease of maintenance. With this product family, PowerTech will soon be able to cover all current market requirements.

## **High-performance SiC semiconductors for maximum power density**

Wherever technically and economically suitable, PowerTech uses state-of-the-art high-performance silicon carbide (SiC) semiconductors – for instance in the PBX55/12-750, with which the new power converter generation celebrated its world premiere at the InnoTrans 2018 trade fair. The device in the power category up to 55 kVA and 750 V DC input voltage is ideal for use in light rail vehicles and metros.

Along with an optimized system architecture, the use of silicon carbide can increase power density by around 50% over the predecessor generation. This is because the SiC semiconductors allow much higher switching frequencies. The magnetic components in the power converter can thus be made more compact and lighter. Weight savings of 35% and a 30% volume reduction have now been achieved as compared with converters based on conventional technology.

▼ The new converter generation "PowerBriX"







# Targeted improvements

The link between the environment and total cost of ownership is closer in an air-conditioning unit than in most vehicle sub-systems. A new simulation tool developed by Knorr-Bremse enables the HVAC system's configuration to be fine-tuned to a vehicle's specific operating profile, climatic conditions and usage.

Michael Powell, Merak Group Technical Director, explains: "In some applications, an air-conditioning system can account for more than a third of the vehicle's total power consumption." This means that even small improvements can have a significant impact on the vehicle's life cycle costs. However, it is not easy to quantify this precisely, due to the many variables involved.

Recently, however, Merak has made important progress in this respect by developing an extensive and complex simulation tool that enables the energy consumption of individual system components to be calculated for a wide range of operating profiles. "The variables taken into account include climatic conditions in the operating region, forecast passenger densities, system configuration and component layout, as well as the various operating modes," the engineer explains. What is important about this new approach is to ensure that the right mix of technologies is applied to a specific application rather than simply because it is seen to be efficient. Application of the wrong technology can have a negative effect on life cycle costs, due to reliability and maintenance issues.



Validated by subsequent testing, the results have sometimes surprised even an expert like Powell. "We are constantly amazed at how certain components or interactions can suddenly become highly significant for overall energy consumption. The key element is to be able to back up conclusions with data. In the field of energy efficiency there is as much misinformation as there is real information. Only with accurate data and simulation can we really optimize the energy efficiency of the system. Normally, the general assumptions are right, but the magnitude of their effect is either over- or understated without real tests and calculations."

### Critical view of peak load operation

The advantage of these simulations is that they enable the engineers to take a more precisely targeted approach to system optimization. The results can be striking: "Most recently we have even reduced energy consumption by up to 20% for certain applications," comments Powell.

For example, a critical look can be taken at the relevance of peak load operations. "In the past, these were often the central focus of efforts to reduce energy consumption." But does such an approach make sense? After all, in most cases an HVAC system only operates under peak load for a few hours per year. Would it not be better to maximize efficiency by focusing on the much more common instances of operation at partial load?

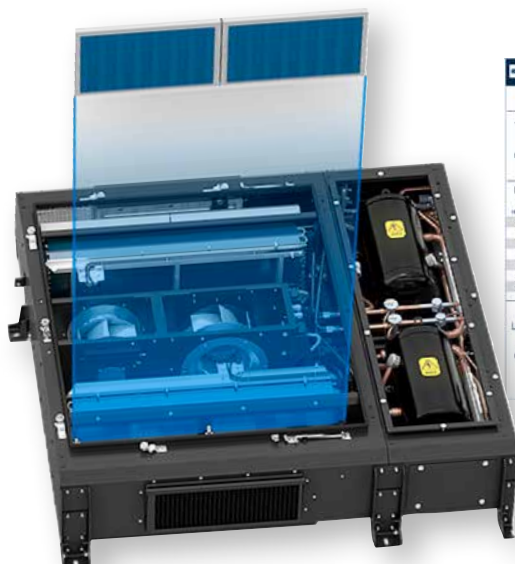
Powell sums up this approach: "The impact of a small improvement over a longer period of time offers operators far greater savings than a bigger percentage improvement that only has an impact for a few hours per year." One positive side effect of the simulation tool is that the optimization process – as well as offering comparable or better performance – usually also improves the unit's weight and reliability.

### Filter elements

Replaceable filters are another significant cost factor for HVAC systems. Conventional filters are highly efficient at first, but their performance rapidly tails off, and they have to be replaced every four to twelve weeks depending on the application. The environment in Germany is not the same as in India, for example. As a result they can account for up to 30% of life cycle costs. Here too, Merak has introduced an improvement, developing a new type of air filter that deteriorates much more slowly and extends maintenance intervals by a factor of up to four. As a result, many maintenance activities can be simply dropped. This approach also brings a very important benefit to the environment: The filters are currently disposed of, which means they are simply put in the bin. By extending maintenance times, significantly less waste is generated.

Filters that are not changed on time do not guarantee proper air exchange rates and consume more power. By having filters that last longer, the efficiency of the equipment is improved and power consumption reduced.

HVAC annual energy consumption and achievable savings calculated using the Energy Analysis tool ▼



◀ Same installation space required for new air filter as for conventional filters



# Integrated sanding

Knorr-Bremse's speed-dependent sanding systems reduce both braking distances and system handling. An integrated approach to sanding, braking and train control management systems (TCMS) adds even more value.

Drizzle, early morning mist, leaves on the line or even just dust – all significantly reduce the wheel-rail friction coefficient on everything from light rail vehicles to passenger trains. The solution is to blow sand between the wheel and the rail. Thanks to sanding, adhesion coefficients that can fall as low as 0.02 in adverse conditions can be brought up to a value of 0.2 for the relevant axle, allowing the train to operate normally.

## 30% less sand

An ingenious brake management system decides how much sand is delivered for a given speed and driving situation. The key is to adjust sand delivery to the current speed. "This significantly reduces the amount of sand used, particularly at speeds below 50 km/h," says Dr. Peter Krieg, Head of Sanding Systems at Knorr-Bremse Rail Vehicle Systems.

This is borne out by the following example: A sanding system delivering sand at a constant rate for a vehicle decelerating at  $2 \text{ m/s}^2$  from a speed of 50 km/h would deliver 500 g of sand. But with speed-dependent sanding, this figure falls to just 350 g.<sup>1</sup> "In routine operation, the reduction can be anywhere up to 30%," says Krieg. As well as saving 30% on the cost of the sand, this also means a 30% reduction in the number of refills required.

## Synergies between sanding, braking and train control management systems

When it comes to incorporating the sanding system into the overall vehicle system, there are various advantages to an integrated approach encompassing the train control management system (TCMS) and braking system. One benefit is that it allows the number of interfaces to be reduced. "If separate sanding, braking and TCMS systems are used, they all need their own interface," explains Krieg. "But you only need one interface if the three systems are integrated." The shared electronics also require less hardware.

One further benefit of this approach is that it reduces running costs, for example by enabling sand drying to be optimized. The contents of independent sandboxes are dried concurrently on all axles, consuming a relatively large amount of energy. The integrated approach allows sand drying to be adjusted to the track conditions, and avoids drying while the vehicle is stationary.

## 2.5% increase in vehicle availability

Another compelling benefit for operators is that the correct functioning of the sanding system can be checked simply by activating it once every 24 hours. In most cases, this means that the time-consuming daily system test is no longer necessary.

The following calculation highlights the difference this can make: Testing the correct functioning of a vehicle with four sanding units would typically take eight minutes. Add to this the journey time from the platform to the testing area and back, and the whole process can easily last half an hour. "By eliminating the need for this test, it is possible to achieve a 2.5% increase in vehicle availability under normal operation."<sup>2</sup> This means that for a planned fleet of 80 trains, the acquisition of up to two trains can be dispensed with.

## Fewer signal and platform overshoots

It is important for operators to ensure that the braking distance is not exceeded during adverse weather conditions and when wheel-rail adhesion is low – especially during automatic train operation. According to brake trials carried out on a multiple unit in the UK in 2017, sanding units can reduce the number of signal and platform overshoots by 96% compared to a control vehicle.<sup>3</sup>

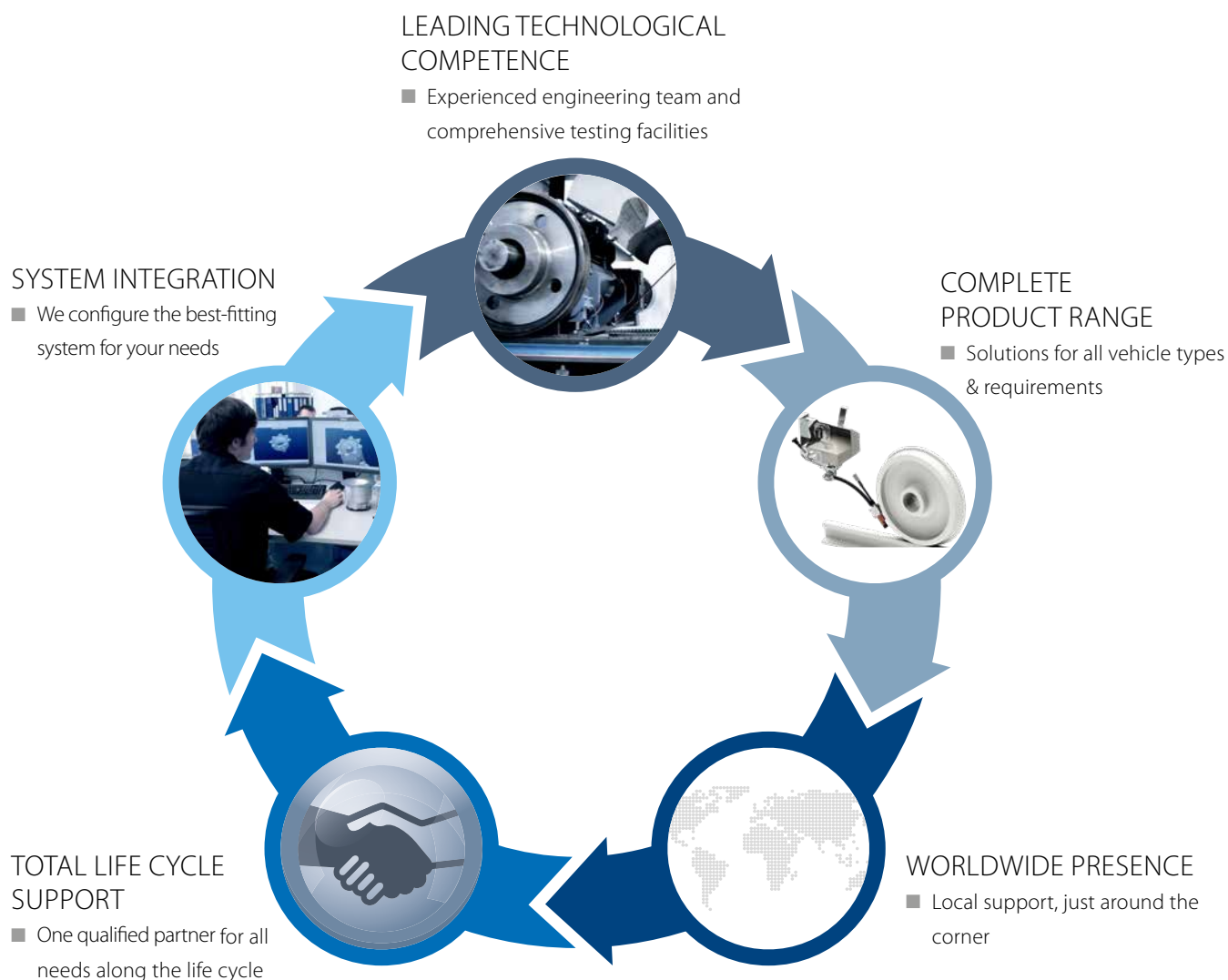
## Knorr-Bremse's sanding systems:

- Customized system solutions for any project and any requirements
- Outstanding acceleration and braking performance under all conditions
- Exceptional systems integration know-how for OE and modernization projects
- Optimized total cost of ownership
- Compliance with the relevant rail industry norms and standards
- Global Knorr-Bremse network for domestic content, service and aftermarket
- Wide range of optional extras such as sand flow sensors, etc.

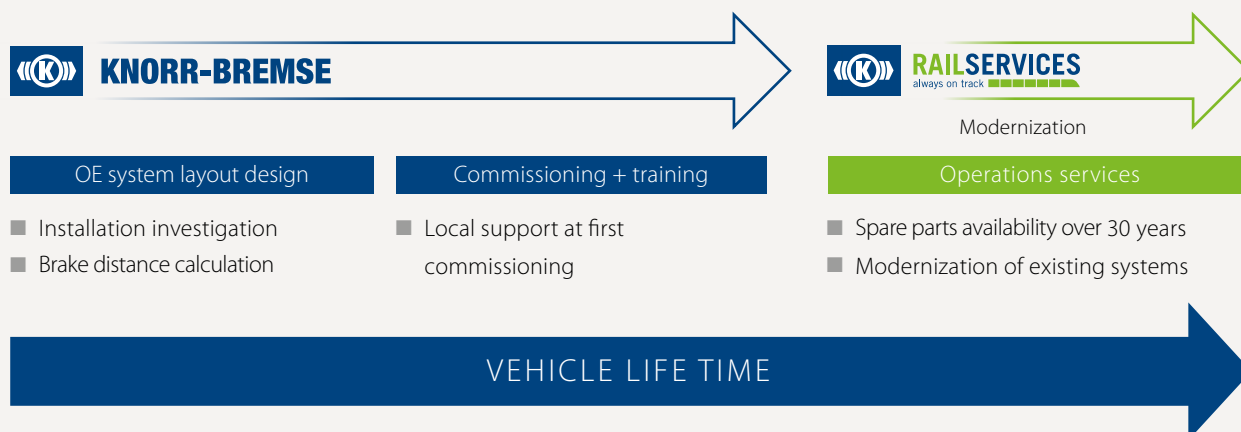
<sup>1</sup>TÜV Rheinland, Report Brake Tests, Bydgoszcz, 2011

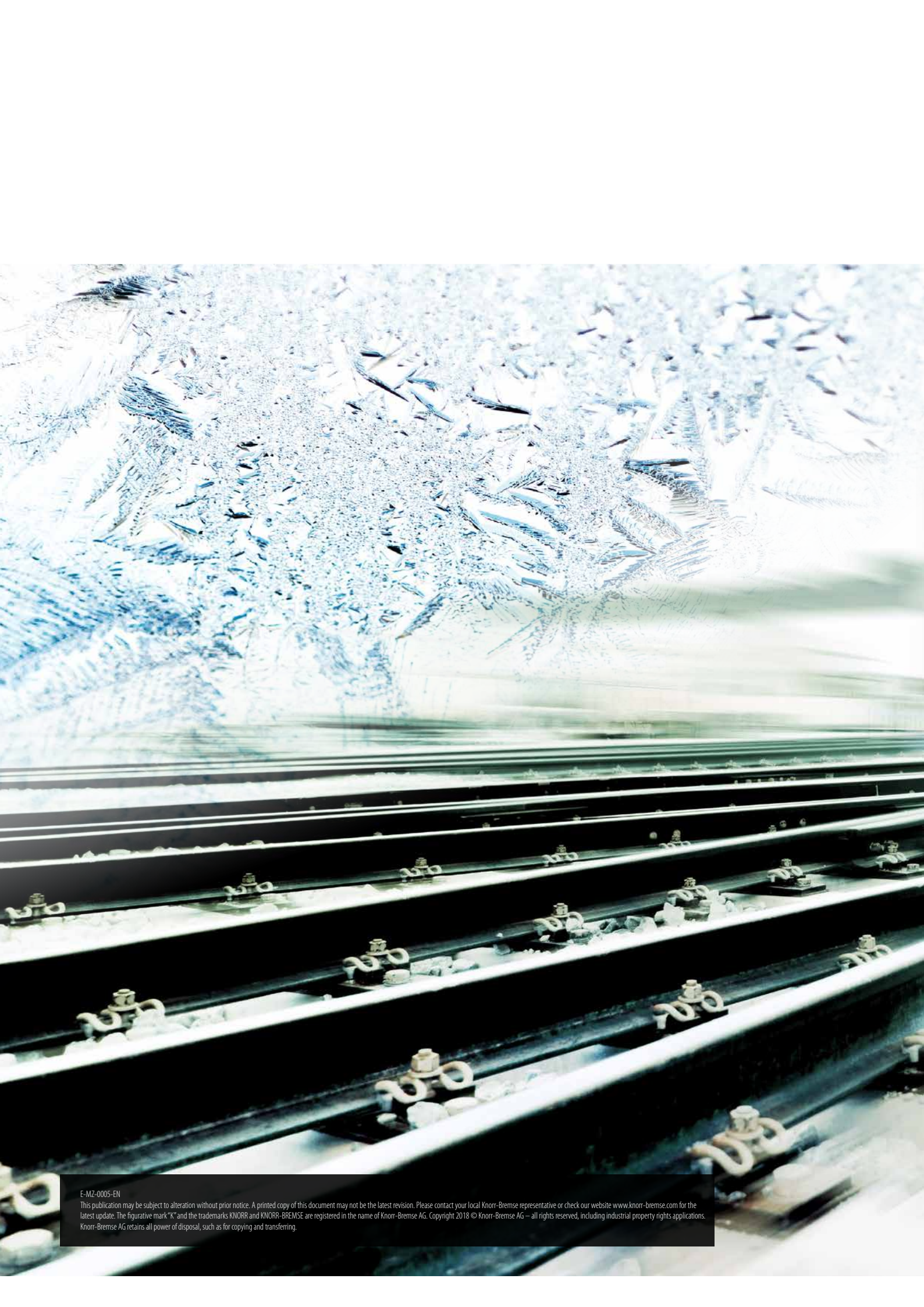
<sup>2</sup>Jürgen Konz, Corporate Representative of S-Bahn Berlin GesmbH, ZEV Rail 137 (2013) p. 5

<sup>3</sup>RSSB, T1107 Trial on Sander Configurations, Research Report 2018



## KNORR-BREMSE PROVIDES SUPPORT AND SERVICES OVER THE ENTIRE LIFE TIME OF VEHICLES





E-MZ-0005-EN

This publication may be subject to alteration without prior notice. A printed copy of this document may not be the latest revision. Please contact your local Knorr-Bremse representative or check our website [www.knorr-bremse.com](http://www.knorr-bremse.com) for the latest update. The figurative mark "K" and the trademarks KNORR and KNORR-BREMSE are registered in the name of Knorr-Bremse AG. Copyright 2018 © Knorr-Bremse AG – all rights reserved, including industrial property rights applications. Knorr-Bremse AG retains all power of disposal, such as for copying and transferring.